APPLICATION FOR A COASTAL ZONE ACT PERMIT

Amended March 2005

State of Delaware
Department of Natural Resources & Environmental Control
Office of the Secretary

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Permit Application Instructions

1. Complete all parts of the application. For sections which are not applicable to your project, do not leave blank; present a statement to that effect and clearly state why the section is not applicable to your project.

2. Where sufficient space is not provided on the application form for requested information, attach extra pages referencing each answer by the appropriate part and question number.

3. Submit three complete copies of the permit application to:

   Department of Natural Resources & Environmental Control
   89 Kings Highway
   Dover, DE 19901

4. Comply if required, or as requested by the DNREC Secretary, with 7 Delaware Code, Chapter 79, Section 7902. If requested, but not made part of your application it will not be considered administratively complete until this form is reviewed.

5. Be sure to include your permit application fee of $3,000; otherwise the application will not be considered administratively complete. Make checks payable to "State of Delaware."

6. This application for a Coastal Zone Act Permit is a public document. Do not include information that you do not wish the public to review. If this application requires you to place confidential information or data in the application to make it administratively complete, note the Delaware Freedom of Information Act, Section 5 (Requests for Confidentiality), for the proper procedure in requesting confidentiality.

7. On the last page of text in this application, the applicant shall clearly print their name.

PART 1

APPLICANT AND SITE IDENTIFICATION

1.1 Identification of the permit applicant:

Name:	**Alma Properties, LLC**
Address:	**529 Terminal Avenue**
	New Castle, DE 19720
Telephone No.:	**302-655-7300**
:Fax No:	**302-658-4075**

1.2 Authorized agent (if any): **None**

Name:

Address:

Telephone No.:

Fax No.:

Include written authorization from client for being authorized agent for this application.

1.3 Project property location (street address):

601 Christiana Avenue

Wilmington, DE 19801

1.4 Provide a general map of appropriate scale to clearly show project site:

See Site Map - Attachment A

PART 2

EVIDENCE OF LOCAL ZONING AND PLANNING APPROVAL

See Evidence of Local Zoning - Attachment B

I, _____,for **The City of Wilmington**
(Name of County, City of Town)

do hereby affirm that the project proposed by **Alma, LLC**
(Name of Applicant)

located at **601 Christiana Avenue, Wilmington, DE 19801**, in
(Address)

the **M-2 – General Industrial** zoning district is in full compliance with the zoning code as it applies to this project.

The above named applicant's project is in compliance with the adopted comprehensive development plan for the geographic area within which the project will be located.

_____
(Signature)

_____
(Title)

_____
(Date)

This part is essential for a complete Permit Application. No application will be considered administratively complete without it. While the applicant is strongly advised to use this form, the local zoning jurisdiction may utilize another form or document than this one to demonstrate "evidence of local zoning approval," but such documents must be signed and dated by the proper official.

PART 3

PROJECT PROPERTY RECORD

3.1 Name and address of project premises owner(s) of record:

Alma Properties, LLC
529 Terminal Avenue
New Castle, DE 19720

3.2 Name and address of project premises equitable owner(s):

Same as 3.1

3.3 Name and address of lessee(s):

N/A

3.4 Is the project premises under option by permit applicant?

No

3.5 What is the present zoning of the land for this entire project site?

M-2 – General Industrial

PART 4

PROJECT OPERATIONS

4.1 Describe the characteristics of the manufactured product and all the process and/or assembly operations utilized by the proposed project. Include in the description (Use attachments if necessary):

a. the raw materials, intermediate products, by-products and final products and characteristics of each. Review any materials' risk of carcinogenicity, toxicity, mutagenicity and/or the potential to contribute to the formation of smog. Provide material safety data sheets (MSDS) if available;

The proposed facility will accept biodegradable material generated from routine yard and landscape maintenance as well as material from land clearing activities. The recyclable yard material to be accepted at the facility will generally consist of grass clippings, leaves, branches, stumps, and non-treated wood. Other untreated wood material which may be required for recycling/reuse will also be accepted at the facility.

The recyclable yard material and other untreated wood accepted at the facility will be recycled at the proposed facility. A variety of mulch ground cover materials will be produced at the facility. This material will be distributed by wholesale companies for both commercial and residential uses.

Approximately 20% of the mulch produced by the facility will be sprayed with water jets containing a colorant material. This colorant is made specifically for mulch material, and will dry in less than 24 hours.

MSDS Mulch Magic Black
MSDS Mulch Magic Bright Brown
MSDS Mulch Magic Dark Brown
MSDS Mulch Magic PF Red

See MSDS Information – Attachment C

b. the step-by-step procedures or processes for manufacturing and/or assembling the product(s). Provide a flow diagram to illustrate procedures;

See Flow Diagram – Attachment D

All incoming vehicles will be visually scanned to prevent non-acceptable material from being deposited on the site. Once visually scanned, the vehicles will be weighed and directed to a

central unloading area where the acceptable material will be deposited. A spotter will visually review the material deposited and will debag all material, as required. The spotter will place any bag remains in covered storage containers for transport to an appropriate disposal facility.

All unacceptable material will be rejected from entering the site during the visual scanning process. Any unacceptable material not intercepted during the initial scanning will, once identified, be segregated and stored in covered storage containers for transport to an appropriate disposal facility.

After being deposited in the unloading area, the material will be high piled using a front end loader or bull dozer. The material will then be removed from the storage pile and placed into a horizontal grinder where it will be reduced to an appropriate size. The grinder will size the material using a built-in screen deck. Some of the mulch material will be stockpiled for shipment at this point.

After one pass through the screen, some material may require additional grinding and sizing depending on the material being processed. This material will be fed through the grinding machine for final processing.

Approximately 20% of the mulch material processed will be colored. This will be accomplished by placing the material in an auger machine that coats the material with a colorant that sprays through a set of nozzles. This system consists of 15 water jets dispensing 40gpm of water based colorant into the mulch. The water and the colorant are held in tanks; the 2000 gallon tanks are filled with water once per day. This colorant enhances the aesthetics of the final product and is made specifically for mulch coloring. The final colored product is dry within twenty-four hours.

Support equipment feeding the material into the equipment or piling it when finished will consist of front end loaders, excavators, and bull dozers.

The finished product will be stockpiled on site until it is ready to be shipped to market.

c. the nature of the materials mentioned above in 4.1 (a) as to whether or not the materials require special means of storage or handling;

The recyclable yard material does not require any special means of storage or handling.

d. list the machinery (new and/or existing) to be utilized by this project;

excavator
front-end loader
dozer
conveyors
horizontal grinders
colorant machine

e. list any new buildings or other facilities;

This project will not require a new building; however a small scale office trailer will be installed.

f. if this project represents a totally new facility at a new or existing facility, what will be the new rate of maximum production, and;

The facility will have the capacity to handle over 500,000 cubic yards of recyclable yard material annually.

g. if this project represents a totally new facility at a new or existing facility, what will be the maximum production rate?

See 4.1 (f) above.

4.2 Describe daily hours of plant operations and the number of operating shifts.

Normal hours of operation will be 7:00am to 3:30pm, Monday through Friday. The facility may, from time to time, extend its hours based on operational and customer needs.

4.3 Provide a site plan of this project with:

See Site Plan – Attachment E

a. a north arrow;

b. a scale of not less than one inch to 200 feet;

c. identity of the person responsible for the plan, including any licenses and their numbers;

d. the acreage of the applicant's entire property and acreage of the proposed project;

e. property lines of entire property;

f. lines designating the proposed project area for which application is being made clearly distinguished from present facilities and operating areas (if any);

g. existing and proposed roads, railroads, parking and loading areas, piers, wharfs, and other transportation facilities;

h. existing water bodies and wetlands and proposed dredge and fill areas, and;

i. existing and proposed drainage ways, gas, electric, sewer, water, roads, and other rights-of-way.

4.4 How many acres of land in total are required for this proposed project, both existing, utilized, developed land (if any), and new land?

Existing land: **8 acres**
New land: **0 acres**

PART 5A

ENVIRONMENTAL IMPACTS

Air Quality

5.1 Describe project emissions (new and/or increased over current) by type and amount under maximum operating conditions:

Pollutant	**Amount (lbs/day)**
a. PM	
b. CO	
c. NOx	**See Table below**
d. SOx	
e. HC	

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1.51	4.15	0.01	5.67
[illegible]	0.38	0.39	0.07	0.84
[illegible]	4.16	3.08	0.86	8.10
[illegible]	0.18	0.19	1.91E-04	0.37
[illegible]	0.05	0.07	0.03	0.15
TOTAL	***6.28***	***7.87***	***0.97***	***15.13***

5.2 Describe how the above emissions change in the event of a mechanical malfunction or human error.

The equipment proposed for the mulch processing facility will be maintained in accordance with manufacturer's recommendations. When properly maintained, these units have an excellent history of providing consistent performance, particularly in this type of service, with a low incidence of failure.

In the event of mechanical malfunction or human error, the unit will be shut down immediately. Upon shutdown, the emissions will cease.

5.3 Describe any pollution control measures to be utilized to control emissions to the levels cited above in 5.1.

Emissions will be controlled by limiting the number of operating hours of the equipment. Other measures will be taken including wetting of the storage piles and access drives.

5.4 Show evidence that applicant has, or will have, the ability to maintain and utilize this equipment listed in 5.3 in a consistently proper and efficient manner. (For example, provide college transcripts and/or records of training courses and summary of experience with this pollution control equipment of person(s) responsible for pollution control equipment, and/or provide copies of contracts with pollution control firms to be responsible for maintaining and utilizing this equipment.)

During start-up, equipment operators will be trained by current supervisory staff or the vendors furnishing the individual pieces of equipment. The training courses will comply with the recommendations of the equipment manufacturers as to course content, duration and frequencies. Training documentation will be maintained on site.

New hires will undergo appropriate training to insure proper operation of the plant equipment.

Water Quality

5.5 Describe any new wastewater discharge or increase over current discharge levels due to this proposed project:

Pollutant	Amount (ppm)
a. **Not Applicable**	
b.	
c.	
d.	
e.	

No waste water will be generated from the processing of the material.

5.6 Describe the current method of employee sanitary wastewater disposal and any proposed changes to that system due to this proposed project.

In the short term, there will be portable toilet facilities on site for employees involved in the operations. It is anticipated that during the 3rd or 4th quarter of 2008, a facility with sanitary connections will be available for use.

5.7 Identify the number, location, and name of receiving water outfall(s) of any and all process wastewater discharge (new or current) affected by this proposed project.

Not applicable. No process wastewater will be generated by this project.

5.8 If any effluent is discharged into a public sewer system, is there any pretreatment program? If so, describe the program.

Not applicable. No effluent will result from this project.

5.9 Identify the number, location, and name of receiving waters of stormwater discharges:

Basin 1 is located near the northwestern border of the site and receives most of the storm water runoff via sheet flow from the asphalt paved area of the site. Flow from Basin 1 discharges to a drainage ditch that is located parallel to Interstate 495 (I-495). The outfall is controlled by a backflow valve designed to prevent water from the drainage ditch entering the basin. The I-495 drainage ditch discharges to the Christina River approximately 1.2 miles west of its confluence with the Delaware River.

a. describe the source of stormwater run-off (roofs, storage piles, parking lots, etc.;

Both processed and unprocessed material will be stored in piles on site. The total amount of material stored on site will vary and will generally be between 30,000 and 200,000 cubic yards. Accordingly, the source of storm water run off will be from the storage piles and from the truck traffic entering the site. This storm water run off will be directed into retention Basin 1 which will be maintained on a regular basis.

b. describe the pollutants likely to be in the stormwater;

The pollutants most likely to be in the storm water run off and entering the retention basin would be from roadway dust, fugitive particulates and normal truck traffic associated with the delivery of material. These contaminants are diverted to the retention basin where they may be effectively controlled from entering the first effluent.

c. describe any pollution control device(s) or management technique(s) to be used to reduce the amount of stormwater generated and devices to improve the quality of the stormwater run-off prior to discharge;

BMP for Stockpiled Materials

- **Divert storm water around storage areas;**
- **Pile materials to minimize surface area exposed to precipitation;**
- **Practice good housekeeping measures such as frequent removal of debris;**
- **Store waste materials in covered dumpsters;**
- **Control fugitive dust through the application of water via spray systems. The materials will absorb the water from**

the existing operations and not generate any appreciable run-off.

- **Control dust on the outdoor portions of the site by keeping traffic on paved roads and using a water truck and street sweeper as necessary.**

d. what amount of stormwater run-off increase over current levels will result from this proposed project;

None

e. describe any new or improved stormwater drainage system required to safely carry off stormwater without flooding project site or neighboring areas down gradient.

None required

5.10 Will this project use a new water intake device, or increase the use (flow) from an existing intake device? If, yes, please state:

No

a. the volume of water to withdrawn, and;

Not applicable. See above.

b. describe what will be done to prevent entrainment and/or entrapment of aquatic life by the intake device.

Not applicable. See above

5.11 Will this proposed project result in a thermal discharge of water, or an increase in the flow or temperature of a current thermal discharge? If yes, state:

No

a. the volume of the new flow or increase from the existing thermal discharge both in flow and amount of heat;

Not applicable. See above.

b. after all cooling water mechanisms have been applied to the hot water, how warm will the water be when it is discharged into a receiving waterway, discharge canal, or ditch and what will be the difference in discharge temperature and ambient temperature (delta T) at various seasons of the year?

Not applicable. See above.

c. what equipment and/or management techniques will be used to reduce the thermal load of the discharge water?

Not applicable. See above.

5.12 Will any proposed (new) discharge or change in existing discharge cause, or have potential to cause, or contribute to the exceedence of applicable criteria appearing in the State of Delaware Surface Water Quality Standards?

No

5.13 Describe any oils discharged to surface waters due to this proposed project.

The receiving/recycling of materials at the facility will not generate any oils. Therefore, no oils will be discharged to surface waters for the proposed project.

5.14 Describe any settleable or floating solid wastes discharged to surface waters due to this project.

None. See 5.9 (c) above detailing BMP's that will be in place.

5.15 Show evidence that the applicant has, or will have, the ability to maintain and utilize any water pollution control equipment listed in questions 5.5 through 5.14 in a consistently proper and efficient manner. (For example, provide college transcripts and/or training courses and summary of prior experience with this pollution control equipment of person(s) responsible for pollution control equipment, and/or provide copies of contracts with pollution control firms.)

Water Quantity

5.16 Identify the source of water needed for the proposed project, including potable water supplies.

Temporarily a 6,000 gallon tank with a pump is on site for this project until a permanent water source is installed. This tank will be filled/refilled daily.

5.17 If wells are to be used, identify the aquifer to be pumped and the depth, size and pumping capacity of the wells and state whether or not a permit has been applied for.

Not applicable. No wells are going to be used for this project. Wells are not permitted on this site.

5.18 Estimate the amount of water to be used for every purpose, including cooling water. State daily and maximum water use in the unit of gallons per day. State if water use will vary with the seasons, time of day or other factors.

The colorant system uses 40gpm (2,400 gallons per day) while in use. We estimate 1,000 hours per year or 2,400,000 gallons annually.

Water for wetting down the stockpiles will also be pumped from the tank on site. Stockpiles will be watered as needed depending on the weather conditions.

5.19 How close is the proposed well(s) to any well on adjacent lands?

Not applicable. Wells are not permitted on the site.

Solid Waste

5.20 Describe each type and volume of any solid waste (inc. biowastes) generated by this project and the means used to transport, store, and dispose of the waste(s).

The proposed process will not generate any solid waste. However, we anticipate that a diminimous amount of solid waste will enter the site in the form of trash bags and other miscellaneous waste that may be mixed in with the recyclable material. This waste will be segregated from the recyclable material and placed in a covered container for transport to an appropriate disposal facility.

5.21 Will there be any on-site recycling, re-use, or reclamation of solid wastes generated by this project?

No. The proposed project will not generate solid waste.

5.22 Will any waste material generated by this project be destroyed on-site? If so, how would that be done?

No.

Hazardous Waste

5.23 Will this proposed project result in the generation of any hazardous waste as defined by the "Delaware Regulations Governing Hazardous Waste?"

No. The project will not result in the generation of hazardous waste as defined by "Delaware Regulations Governing Hazardous Waste".

5.24 If so, identify which hazardous waste, the amount of each, and how it is generated.

Not applicable. See 5.23 above.

5.25 Describe the transport of any hazardous waste and list the permitted hazardous waste haulers to be utilized.

Not applicable. See 5.23 above.

5.26 Will the proposed project cause the applicant to store, treat, and/or dispose of hazardous waste?

No.

5.27 Does the applicant currently generate any hazardous waste at this site?

No.

Habitat Protection

5.28 What is the current use of the land that is to be used for the proposed project?

The land is currently being used to receive, store and ship bulk materials. In addition, it has been used to store new automobiles and lumber products. These operations will be consolidated and/or relocated to accommodate the proposed project.

5.29 Will the proposed project result in the loss of any wetland habitat? If so, answer the following:

No.

a. will any wastewater and/or stormwater be discharged into a wetland, and;

Not applicable. See 5.29 above.

b. if so, will the discharge water be of the same salinity as the receiving wetlands?

Not applicable. See 5.29 above.

5.30 Will the proposed project result in the loss of any undisturbed natural habitat or public use of tidal waters? If so, how many acres?

No.

5.31 Do threatened or endangered species (as defined by the DNREC and/or the Federal Endangered Species Act) exist at the site of the proposed project, or immediately adjacent to it? If so, list them.

See Endangered Species Letter - Attachment F

Attached is a letter from Edna J. Stetzer, Biologist/Environmental Review Coordinator for DNREC Natural Heritage and Endangered Species Division confirming there are no threatened or endangered species on or immediately adjacent to the site. This letter was received in May 2007 in conjunction with another project on this site.

5.32 Will this proposed project have any effect on these threatened or endangered species (as defined by the DNREC and/or the Federal Endangered Species Act).

Not Applicable. See 5.31 above.

5.33 What assurances can be made that no threatened or endangered species exist on the site of the proposed project site?

Not Applicable. See 5.31 above.

5.34 Describe any filling, dredging, or draining that may affect nearby wetlands or waterways.

There will be no filling, dredging or draining.

5.35 If dredging is proposed, how much will occur and where will the dredged materials go for disposal?

There will be no dredging.

Other Environmental Effects

5.36 Describe any effects noticeable of the proposed project site including: heat, glare, noise, vibration, radiation, electromagnetic interference, and odors.

The facility will not produce any heat, glare, radiation or electromagnetic interference.

The process equipment and the site operations in general will comply with the Delaware Regulations Governing the Control of Noise. Noise generated by the heavy equipment and truck traffic at the site will be less than or equivalent to the current level generated by similar equipment currently operating in this heavy industrial area near the Port of Wilmington. High truck traffic volumes and noise generating facilities dominate the immediate area so noise from this operation will not degrade the surrounding environment. Average noise levels are 87 Db no grinding, 92 Db grinding.

The facility will handle non-putrescible, bio-degradable materials and, based on the makeup of this material and the proposed products, we do not anticipate any unacceptable odors. However, various techniques for reducing odors will be available should odor reduction become necessary. Additionally, the location of the site away from residential or other sensitive receptors and the buffer space between other operations significantly reduces the potential issues.

The facility will control fugitive dust resulting from operations through the application of water via spray systems. The facility will control dust on the outdoor portions of the site by keeping traffic on paved roads and using a water truck and street sweeper as necessary.

5.37 Describe what will be done to minimize and monitor such effects.

See 5.36 above.

5.38 Describe any effect this proposed project will have on public access to tidal waters.

This project will have no effect on public access to tidal waters.

5.39 Provide a thorough scenario of the proposed project's potential to pollute should a major equipment malfunction or human error occur, including a description of backup controls and safety provisions planned for this project to minimize any accidents.

Due to the nature of the proposed recycling operation, no major mechanical malfunction or human error would have a potential to pollute. If the grinding and/or colorizing equipment were to malfunction it would generally result in a shutdown of the process.

5.40 Describe how the air, water, solid and hazardous waste streams, emissions, or discharge change in the event of a major mechanical malfunction or human error.

Any malfunction of the grinding equipment would generally result in a shutdown of the process. Therefore, it is anticipated that there will be no additional effect on air, water, solid and hazardous waste streams emissions or discharge.

PART 5B

ENVIRONMENTAL OFFSET PROPOSAL REDUCTION CLAIM

Is applicant claiming the right to have a reduced offset proposal due to past voluntary improvements as defined in the Regulations Governing Delaware's Coastal Zone?

Circle one below

YES

(NO)

If yes, provide an attachment to the application presenting sufficient tangible documentation to support your claim.

PART 5C

ENVIRONMENTAL OFFSET PROPOSAL

If the applicant or the Department finds that an Environmental Offset Proposal is required, the proposed offset project shall include all the information needed to clearly establish:

A. A qualitative and quantitative description of how the offset project will more than offset the negative impacts from the proposed project.

B. How the offset project will be carried out and in what period of time.

C. What the environmental benefits will be and when they will be achieved.

D. What scientific evidence there is concerning the efficacy of the offset project in producing its intended results.

E. How the success or failure of the offset project will be measured in the short and long term.

F. What, if any, negative impacts are associated with the offset project.

G. How the offset will impact the attainment of the Department's environmental goals for the Coastal Zone and the environmental indicators used to assess long-term environmental quality within the Coastal Zone.

The offset proposals must clearly and demonstrably* more than offset any new pollution from the applicant's proposed project. The applicant can claim (with documentation) evidence of past voluntary environmental investments (as defined in the Regulations) implemented prior to the time of application. Where the Department concurs with the applicant that such has occurred, the positive environmental improvement of the offset proposal against the new negative impact can be somewhat reduced.

The applicant must complete the Coastal Zone Environmental Impact Offset Matrix. This matrix can be found on the same web site as this application. The matrix is found at 'CZA Matrix' just below this site. On page one, the applicant must list <u>all</u> environmental impacts in the column labeled "Describe Environmental Impacts". In the column to the immediate right, the applicant should reference the page number of the application or attachment which documents each impact listed. In the "Describe Environmental Offset Proposal" column, applicant must state what action is offsetting the impact. The offset

action shall be referenced by page number in the column to the right to show how the offset will work.. The applicant shall not utilize the far right column.

In the above, the entire offset proposal, including the matrix, shall be available to the public, as well as the evidence of past voluntary environmental enhancements.

See Proposed Offset Plan for Recyclable Yard Material Facility (Attachment G)

* For purposes of this requirement, the DNREC will interpret the phrase "clearly and demonstrably" to mean an offset proposal that is obviously so beneficial without detailed technical argument or debate. The positive environmental benefits must be obviously more beneficial to the environment than the new pollution that minimal technical review is required by the Department and the public to confirm such. The total project must have a positive environmental impact. The burden of proof is on the applicant.

PART 6

ECONOMIC EFFECTS

Construction

6.1 Estimate the total number of workers for project construction and the number to be hired in Delaware.

No construction required; site improvements in place.

6.2 Estimate the weekly construction payroll.

Not applicable.

6.3 Estimate the value of construction supplies and services to be purchased in Delaware.

Not applicable.

6.4 State the expected dates of construction initiation and completion.

Not applicable.

6.5 Estimate the economic impact from loss of natural habitat or any adverse economic effects degraded water or air quality will have on individuals indirectly or directly dependent on that habitat or air or water quality (e.g. commercial fishermen, waterfowl guides, trappers, fishing guides, and charter or head boat operators and bait and tackle dealers.

Not applicable.

Operations

6.6 State the number of new employees to be hired as a direct result of this proposed project and how many of them will be existing Delaware residents and how many will be transferred in from other states.

At a minimum, the facility will have three employees, a weigh master, an inspector and an equipment operator. There will be approximately three new hires, all from Delaware.

6.7 If employment attributable to the proposed project will vary on a seasonal or periodic basis, explain the variation and estimate the number of employees involved.

Employment will be year-round, not seasonal.

6.8 Estimate the percent distribution of annual wages and salaries (based on regular working hours) for employees attributable to this project:

Wage/salary	Percent of employees
$12,001-20,000	
$20,001-29,000	67%
$29,001 -39,000	
$39,001 and over	33%

6.9 Estimate the annual taxes to be paid in Delaware attributable to this proposed project:

State personal income taxes: **$5,820**
State corporate income taxes: **$40,200**
County and School District taxes: **Not Applicable**
Municipal taxes: **Not Applicable**

Alma LLC pays annual County, School and Municipal taxes on this property; however, it is not attributable to this specific project.

PART 7

SUPPORTING FACILITIES REQUIREMENTS

Describe the number and type of new supporting facilities and services that will be required as a result of the proposed project including, but not limited to:

Roads **None**

Bridges **None**

Piers and/or docks **None**

Railroads **None**

Microwave towers **None**

Special fire protection services not now available **None**

Traffic signals **None**

Sewer expansion **None**

Energy related facilities expansion **None**

Pipelines **None**

PART 8

AESTHETIC EFFECTS

8.1 Describe whether the proposed project will be located on a site readily visible from a public road, residential area, public park, or other public meeting place (such as schools or cultural centers).

The proposed project is on a site readily visible from Christiana Avenue and the I-495 bridge. There are no residential areas, public parks or other public meeting places within this area.

8.2 Is the project site location within half a mile of a place of historic or scenic value?

The project site is not within half a mile of any historic or scenic areas.

8.3 Describe any planned attempt to make the proposed facility aesthetically compatible with its neighboring land uses. Include schematic plans and/or drawings of the proposed project after it is complete, including any landscaping and screening.

The neighboring land uses for this site are also zoned M-2, General Industrial, and consist of a concrete crushing operation and a lumber yard. The proposed facility would be compatible with its neighboring land uses.

PART 9

EFFECTS ON NEIGHBORING LAND USES

9.1 How close is the nearest year-round residence to the site of this proposed project?

Approximately 0.25 miles

9.2 Will this proposed project interfere with the public's use of existing public or private recreational facilities or resources?

No.

9.3 Will the proposed project utilize or interfere with agricultural areas?

No.

9.4 Is there any possibility that the proposed project could interfere with a nearby existing business, commercial or manufacturing use?

No.

If applicable, the applicant needs to comply with 7 Del. Code, Chapter 79, as part of this application.

Alma Properties, LLC filed an Applicant Background Statement on 5/3/06 associated with the DCDR Facility proposed for this location. There have been no changes to any of the information on that statement.

CERTIFICATION BY APPLICANT

I hereby certify that all the information contained in this Permit Application and in any attachments is true and complete to the best of my belief.

I hereby acknowledge that any falsification or withholding of information will be grounds for denial of a Coastal Zone Permit.

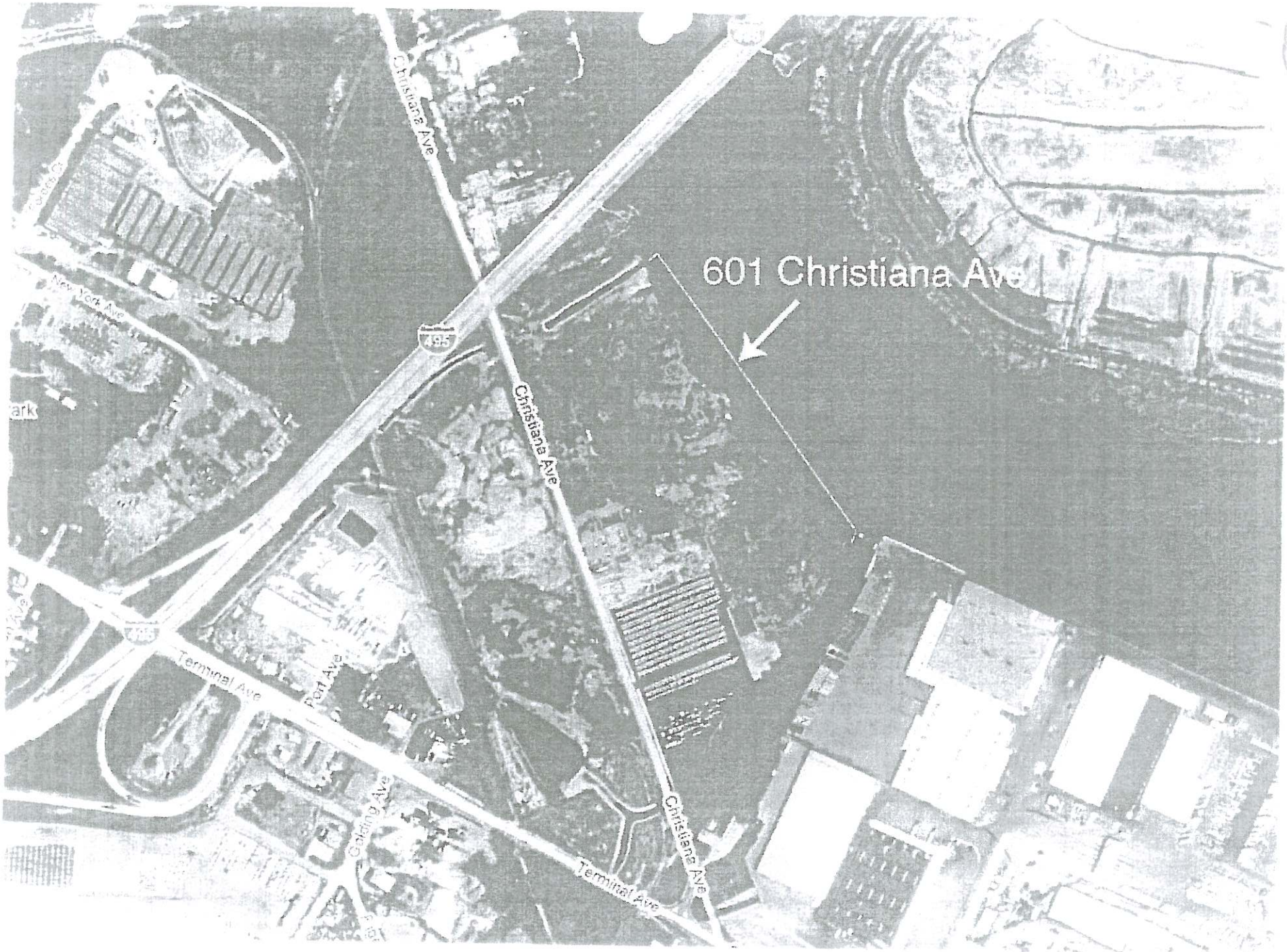
I also hereby acknowledge that all information in this application will be public information subject to the Delaware Freedom of Information Act except for clearly identified proprietary information agreed to by the Secretary of the Department of Natural Resources & Environmental Control .

Mary A. Thomas
Print Name of Applicant

Signature of Applicant

Managing Member
Title

November 12, 2007
Date


601 Christiana Ave
Christiana Ave
Christiana Ave
Christiana Ave
Terminal Ave
Terminal Ave
Port Ave
Golding Ave
New York Ave
I-95

JAMES M. BAKER
MAYOR

City of Wilmington
Delaware

LOUIS L. REDDING - CITY/COUNTY BUILDING
800 FRENCH STREET
WILMINGTON, DELAWARE
19801 - 3537

February 13, 2007

Ms Lynn Carre
Alma, LLC
601 Christiana Avenue
Wilmington, Delaware 19801

Re: 601 Christiana Avenue

Dear Ms Carre:

Pursuant to your request, please be advised that the subject property is located in an area zoned M-2 and that the proposed use of the premises for the processing of yard waste material for a mulch product is permitted as a matter of right per Wilmington City Code section 48-247(b).

Further be advised that this approval does not authorize the manufacture or compounding of fertilizer and that the process is subject to compliance with the standards of external effects and storage requirements contained in Wilmington City Code sections 48-247(e) and 48-475, respectively.

If I can be of further assistance with this matter, pleas don't hesitate to call or write.

Respectfully,

James G. DiPinto
Zoning Manager
Department of Licenses & Inspection

Material Safety Data Sheet

Product Name: Mulch Magic Black
Product Code: BUI/MMBLACK

HMIS Codes: H F R P
1 1 0 X

Section I – Manufacturer Identification

Manufacturer's Name: Becker Underwood, Inc.
Address: P.O. Box 667, 801 Dayton Ave., Ames, IA 50010
Emergency Phone: Chemtrec (800) 424-9300
Information Phone: (515) 232-5907
Prepared By: MSDS Coordinator
Date Revised: November 2, 2004

Section II – Ingredients and Hazards

Ingredient Name **Occupational Exposure Limits**

Component	CAS Number	OSHA PEL	ACGIH TLV	Weight Percent
Carbon Black*	1333-86-4	3.5 mg/m^3	3.5 mg/m^3	> 1.0%

* Exposure levels for carbon black are not applicable when product is in liquid form.
No reportable quantities of toxic chemical(s) subject to the reporting requirements of Section 313 of SARA Title III and of 40 CFR 372 are present

Section III - Physical/Chemical Characteristics

Boiling Point: NE
Specific Gravity: (H_20 = 1): 1.0-1.2
Vapor Density: NE
Evaporation Rate: NE
Solubility in Water: Soluble
Appearance and Odor: Black liquid, mild odor

Section IV - Fire and Explosion Hazard Data:

Flash Point: NA
Method Used: NA
Flammable Limits in Air by Volume: NA
Lower: NA **Upper:** NA
Extinguishing Media: Foam, alcohol foam, CO2, dry chemical, water fog
Fire Fighting Precautions & Hazards: Fire fighters should wear butyl rubber boots, gloves, and body suit and a NIOSH/MSHA self-contained breathing apparatus.
Unusual Fire and Explosion Hazards: Not a fire or explosion hazard when stored under normal conditions.

Section V – Reactivity Data

Stability: Stable
Conditions to Avoid: Extremes in temperature. High humidity.
Incompatibility (Materials to Avoid): Excessive heat and strong oxidizers such as chlorates, bromates, and nitrates.
Hazardous Decomposition Products: When involved in a fire, burning may evolve noxious fumes which may include carbon monoxide, carbon dioxide, nitrous oxides, acetic acid, or other toxic compounds depending on the chemical composition and combustion conditions. However, all of the water must be driven off first for this to occur.
Hazardous Polymerization: Will not occur.

Section VI - Health Hazard Data

Inhalation Health Risks and Symptoms of Exposure: Prolonged inhalation may lead to respiratory tract irritation.
Skin and Eye Contact Health Risks and Symptoms of Exposure: Prolonged or repeated contact may result in mechanical irritation.
Skin Absorption Health risks and Symptoms of Exposure: None expected.
Ingestion Health Risks and Symptoms of Exposure: Ingestion of large quantities may be harmful.
Health Hazards (acute and chronic): None known.
Carcinogenicity NTP? No **IARC Monographs?** No
Existing Medical Conditions Generally Aggravated By Exposure: May provoke asthmatic response in persons with asthma who are sensitive to airway irritants.

Section VI - Health Hazard Data (Continued)

Emergency and First Aid Procedures:

Eyes: Flush with flowing water for at least 15 minutes. Call a physician.

Skin: Wash affected area with soap and water. If irritation develops consult a physician. Remove and launder contaminated clothing before reuse.

Inhalation: If difficulty in breathing occurs, move to fresh air. Get immediate medical attention.

Ingestion: Get immediate medical attention. Unless advised otherwise, dilute with water or milk.

Section VII – Precautions for Safe Handling and Use

Steps to be Taken In Case Material Is Released or Spilled: Contain the spill to prevent a large discharge to surface streams or storm sewers. An absorbent material would aid in cleaning up a liquid spill. If liquid cleanup is necessary, collect in drums, buckets, or other containers.

Waste Disposal Method: The environmental concern is discoloration of land or water. Disposal must be made in accordance with federal, state, and local regulation.

Precautions to be Taken In Handling and Storing: Local exhaust. Do not freeze. Avoid unnecessary skin contact. Do not breathe fumes.

Other Precautions: Eye wash fountains should be easily accessible. As with all chemicals, keep out of the reach of children.

Section VIII - Control Measures

Respiratory: If excessive vapors or mists are generated, wear NIOSH/MSHA approved organic vapor/mist respirator.

Ventilation: Use local exhaust to control excessive vapors/mists. If applicable, proper personal protection is a NIOSH/MSHA approved respirator.

Clothing: Gloves, coveralls, apron, boots as necessary to prevent skin contact as needed.

Eye: Chemical goggles; wear face shield if splashing hazard exists.

Other: Open wounds or skin surface disruptions should be covered with a chemical resistant patch to minimize absorption risks. Clean clothing should be worn daily to avoid possible long-term build up of the product leading to chronic overexposure.

Section IX - Shipping and Labeling Information

D.O.T. Shipping Data: Not regulated.

D.O.T. Hazard Classification NA

D.O.T. Labels Required: NA

D.O.T. Identification NA

Section X - Disclaimer

The opinions expressed herein are those of qualified persons with Becker Underwood, Inc. We believe the information contained here is current as of the date of this Material Safety Data Sheet. Since the use of this product is not within the control of Becker Underwood, Inc., it is the user's obligation to determine a safe end use of this product.

Material Safety Data Sheet

Product Name: MULCH MAGIC BRIGHT BROWN
Product Code: 3MJ.64Z

HMIS Codes: H F R P
2 1 O D

Section I - Manufacturer Identification

Manufacturer's Name: Becker-Underwood
Emergency Phone: Chemtrec (800) 424-9300
Prepared By: Teresa C. Sjulin

Address: 801 Dayton Avenue, Ames, Iowa 50010
Information Phone: (515) 232-5907
Date Revised: September 22, 1998

Section II - Hazardous Ingredients/SARA III Information

*** No reportable quantities of hazardous ingredients are present ***
*** No toxic chemical(s) subject to the reporting requirements of section 313 of Title III and of 40 CFR 372 are present ***

Section III - Physical/Chemical Characteristics

Boiling Point: 100° C
Vapor Density: Of water
Solubility in Water: Disperses in water
pH: 8.0-10.0

Specific Gravity: (H_20 = 1): 1.40-2.20 g/m.L.
Evaporation Rate: Slower than water
Appearance and Odor: Thick liquid, mild odor

Section IV - Fire and Explosion Hazard Data:

Flash Point: N.A. **Method Used:** N.A.
Flammable Limits in Air by Volume: **Lower:** NE **Upper:** NE
Extinguishing Media: Waterfog, Carbon Dioxide, Dry Chemical
Fire Fighting Precautions & Hazards: Use NIOSH/MSHA approved self-contained breathing apparatus and protective clothing when extinguishing. Use water spray to keep fire exposed containers cool.
Unusual Fire and Explosion Hazards: None known.

Section V - Reactivity Data

Stability: Stable
Incompatibility (Materials to Avoid): Strong oxidizing agents, high heat sources, sparks, open flames.
Hazardous Decomposition Products: When involved in a fire, burning may evolve noxious fumes which may include carbon monoxide, carbon dioxide, nitrous oxides, hydrogen chloride, or other toxic compounds. However, all of the water must be driven off first for this to occur.
Hazardous Polymerization: None known.

Section VI - Health Hazard Data

Inhalation Health Risks and Symptoms of Exposure: None known.
Skin and Eye Contact Health Risks and Symptoms of Exposure: May cause mechanical irritation to skin and eyes.
Health Hazards (acute and chronic):
Existing Medical Conditions Generally Aggravated By Exposure: May provoke asthmatic response in persons with asthma who are sensitive to airway irritants.
Emergency and First Aid Procedures: None known.
Eyes: Flush eyes with generous amounts of water for at least 15 minutes. Call a physician if irritation persists.
Skin: Wash exposed areas with copious amounts of soap and water.
Inhalation: Remove patient to fresh air and provide oxygen if breathing is difficult.
Ingestion: If swallowed, dilute with water and induce vomiting. Never give fluids or induce vomiting if the victim is unconscious or having convulsions. Get immediate medical attention.

Section VII - Precautions for Safe Handling and Use

Steps to be Taken in Case Material is Released or Spilled: Contain the spill to prevent discharge to surface streams or storm sewers. Since landfill operations will not accept liquid waste, allow to dry if possible before collecting for disposal. An absorbent material would aid in cleaning up a liquid spill. If liquid cleanup is necessary, collect in drums, buckets, or other containers. Scrub spill area with detergent, flush with copious amounts of water.

Waste Disposal Method: The environmental concern is discoloration of land or water. If possible, the product should be dried before disposal. Disposal must be made in accordance with federal, state, and local regulations.

Precautions to be Taken in Handling and Storing: Local exhaust. Do not freeze. Avoid unnecessary skin contact. Do not breathe fumes.

Other Precautions: Eye wash fountains should be easily accessible. As with all chemicals, keep out of the reach of children

Section VIII - Control Measures

Respiratory: If vapors or mists are generated, wear NIOSH/MSHA approved organic vapor/mist respirator.
Ventilation: Use local exhaust to control vapors/mists if applicable.
Clothing: Gloves, coveralls, apron, boots as necessary to prevent skin contact.
Eye: Chemical goggles, wear face shield if splashing hazard exists.

Section IX - Shipping and Labeling Information

D.O.T. Shipping Data: Not regulated.
D.O.T. Hazard Classification NA
D.O.T. Labels Required: NA
D.O.T. Identification NA

Section X - Disclaimer

The opinions expressed herein are those of qualified persons within Becker-Underwood, Inc. We believe the information contained here is current as of the date of this Material Safety Data Sheet. Since the use of this product is not within the control of Becker-Underwood, Inc., it is the user's obligation to determine a safe end use of this product.

Material Safety Data Sheet

Product Name: MULCH MAGIC DARK BROWN
Product Code: BUI/MMDB

HMIS Codes: H F R P
1 1 0 X

Section I – Manufacturer Identification

Manufacturer's Name: Becker Underwood, Inc.
Address: P.O. Box 667, 801 Dayton Ave., Ames, IA 50010
Emergency Phone: Chemtrec (800) 424-9300
Information Phone: (515) 232-5907
Prepared By: MSDS Coordinator
Date Revised: June 17, 2004

Section II – Ingredients and Hazards

Ingredient Name **Occupational Exposure Limits**

Component	CAS Number	OSHA PEL	ACGIH TLV	Weight Percent
**Diethylene Glycol Monobutyl Ether	112-34-5	NE	NE	0-3%
Carbon Black*	1333-86-4	3.5 mg/m^3	3.5 mg/m^3	0-25 %
Iron Oxide*	1309-37-1	10 mg/m^3 (iron oxide fume)	5 mg/m^3 (iron oxide dust & fume)	>1.0%

**Denotes ingredients that are subject to the reporting requirements of SARA Title III Section 313 and 40 CFR 372.
* Exposure levels for carbon black and iron oxide are not applicable when product is in liquid form.

Section III - Physical/Chemical Characteristics

Boiling Point: NE
Specific Gravity: (H_20 = 1): 1.3-2.3
Vapor Density: Heavier than air
Evaporation Rate: Slower than ether
Solubility in Water: Soluble
Appearance and Odor: Thick liquid, mild odor

Section IV - Fire and Explosion Hazard Data:

Flash Point: > 212° F
Method Used: NA
Flammable Limits in Air by Volume: NA
Lower: NA **Upper:** NA
Extinguishing Media: Foam, alcohol foam, CO2, dry chemical, water fog
Fire Fighting Precautions & Hazards: Fire fighters should wear butyl rubber boots, gloves, and body suit and a NIOSH/MSHA self-contained breathing apparatus.
Unusual Fire and Explosion Hazards: Not a fire or explosion hazard when stored under normal conditions.

Section V – Reactivity Data

Stability: Stable
Conditions to Avoid: Extremes in temperature. High humidity.
Incompatibility (Materials to Avoid): Long term storage in direct contact with reactive metals such as aluminum, zinc, copper, nickel, magnesium, etc. Other materials to avoid include strong oxidizing agents.
Hazardous Decomposition Products: When involved in a fire, burning may evolve noxious fumes which may include carbon monoxide, carbon dioxide, nitrous oxides, acetic acid, or other toxic compounds depending on the chemical composition and combustion conditions. However, all of the water must be driven off first for this to occur.
Hazardous Polymerization: Will not occur.

Section VI - Health Hazard Data

Inhalation Health Risks and Symptoms of Exposure: Prolonged inhalation may lead to respiratory tract irritation.
Skin and Eye Contact Health Risks and Symptoms of Exposure: Prolonged or repeated contact may result in mechanical irritation.
Skin Absorption Health risks and Symptoms of Exposure: None expected.
Ingestion Health Risks and Symptoms of Exposure: Ingestion of large quantities may be harmful.
Health Hazards (acute and chronic): None known.

Section VI - Health Hazard Data (Continued)

Carcinogenicity NTP? No **IARC Monographs?** No

Existing Medical Conditions Generally Aggravated By Exposure: May provoke asthmatic response in persons with asthma who are sensitive to airway irritants.

Emergency and First Aid Procedures:

Eyes: Flush with flowing water for at least 15 minutes. Call a physician.

Skin: Wash affected area with soap and water. If irritation develops consult a physician. Remove and launder contaminated clothing before reuse.

Inhalation: If difficulty in breathing occurs, move to fresh air. Get immediate medical attention.

Ingestion: Get immediate medical attention. Unless advised otherwise, dilute with water or milk.

Section VII – Precautions for Safe Handling and Use

Steps to be Taken in Case Material is Released or Spilled: Contain the spill to prevent a large discharge to surface streams or storm sewers. An absorbent material would aid in cleaning up a liquid spill. If liquid cleanup is necessary, collect in drums, buckets, or other containers.

Waste Disposal Method: The environmental concern is discoloration of land or water. Disposal must be made in accordance with federal, state, and local regulation.

Precautions to be Taken in Handling and Storing: Local exhaust. Do not freeze. Avoid unnecessary skin contact. Do not breathe fumes.

Other Precautions: Eye wash fountains should be easily accessible. As with all chemicals, keep out of the reach of children.

Section VIII - Control Measures

Respiratory: If excessive vapors or mists are generated, wear NIOSH/MSHA approved organic vapor/mist respirator.

Ventilation: Use local exhaust to control excessive vapors/mists. If applicable, proper personal protection is a NIOSH/MSHA approved respirator.

Clothing: Gloves, coveralls, apron, boots as necessary to prevent skin contact as needed.

Eye: Chemical goggles; wear face shield if splashing hazard exists.

Other: Open wounds or skin surface disruptions should be covered with a chemical resistant patch to minimize absorption risks. Clean clothing should be worn daily to avoid possible long-term build up of the product leading to chronic overexposure.

Section IX - Shipping and Labeling Information

D.O.T. Shipping Data: Not regulated.

D.O.T. Hazard Classification NA

D.O.T. Labels Required: NA

D.O.T. Identification NA

Section X - Disclaimer

The opinions expressed herein are those of qualified persons with Becker Underwood, Inc. We believe the information contained here is current as of the date of this Material Safety Data Sheet. Since the use of this product is not within the control of Becker Underwood; Inc., it is the user's obligation to determine a safe end use of this product.

Material Safety Data Sheet

Product Name: MULCH MAGIC PF RED
Product Code: BUI/MMRED

HMIS Codes: H F R P
1 1 0 X

Section I – Manufacturer Identification

Manufacturer's Name: Becker Underwood, Inc.
Address: P.O. Box 667, 801 Dayton Ave., Ames, IA 50010
Emergency Phone: Chemtrec (800) 424-9300
Information Phone: (515) 232-5907
Prepared By: MSDS Coordinator
Date Revised: May 8, 2002

Section II –Ingredients and Hazards

Ingredients **Occupational Exposure Limits**

Component	CAS Number	OSHA PEL	ACGIH TLV	Weight Percent
Iron Oxide*	1309-37-1	10 mg/m^3 (iron oxide fume)	5 mg/m^3 (iron oxide dust & fume)	>1.0%

No reportable quantities of toxic chemical(s) subject to the reporting requirements of Section 313 of SARA Title III and of 40 CFR 372 are present

* Exposure levels for iron oxide are not applicable when product is in liquid form.

Section III - Physical/Chemical Characteristics

Boiling Point: NE
Specific Gravity: (H_20 = 1): 2.1-2.3
Vapor Density: Heavier than air
Evaporation Rate: Slower than ether
Solubility in Water: Soluble
Appearance and Odor: Thick liquid, mild odor

Section IV - Fire and Explosion Hazard Data:

Flash Point: NA
Method Used: NA
Flammable Limits in Air by Volume: NA
Lower: NA **Upper:** NA
Extinguishing Media: Foam, alcohol foam, CO2, dry chemical, water fog
Fire Fighting Precautions & Hazards: Fire fighters should wear butyl rubber boots, gloves, and body suit and a NIOSH/MSHA self-contained breathing apparatus.
Unusual Fire and Explosion Hazards: Not a fire or explosion hazard when stored under normal conditions.

Section V – Reactivity Data

Stability: Stable
Conditions to Avoid: Extremes in temperature. High humidity.
Incompatibility (Materials to Avoid): Long term storage in direct contact with reactive metals such as aluminum, zinc, copper, nickel, magnesium, etc. Other materials to avoid include strong oxidizing agents.
Hazardous Decomposition Products: When involved in a fire, burning may evolve noxious fumes which may include carbon monoxide, carbon dioxide, nitrous oxides, acetic acid, or other toxic compounds depending on the chemical composition and combustion conditions. However, all of the water must be driven off first for this to occur.
Hazardous Polymerization: Will not occur.

Section VI - Health Hazard Data

Inhalation Health Risks and Symptoms of Exposure: Prolonged inhalation may lead to respiratory tract irritation.
Skin and Eye Contact Health Risks and Symptoms of Exposure: Prolonged or repeated contact may result in mechanical irritation.
Skin Absorption Health risks and Symptoms of Exposure: None expected.
Ingestion Health Risks and Symptoms of Exposure: Ingestion of large quantities may be harmful.
Health Hazards (acute and chronic): None known.
Carcinogenicity NTP? No **IARC Monographs?** No
Existing Medical Conditions Generally Aggravated By Exposure: May provoke asthmatic response in persons with asthma who are sensitive to airway irritants.

Section VI - Health Hazard Data (Continued)

Emergency and First Aid Procedures:

Eyes: Flush with flowing water for at least 15 minutes. Call a physician.

Skin: Wash affected area with soap and water. If irritation develops consult a physician. Remove and launder contaminated clothing before reuse.

Inhalation: If difficulty in breathing occurs, move to fresh air. Get immediate medical attention.

Ingestion: Get immediate medical attention. Unless advised otherwise, dilute with water or milk.

Section VII – Precautions for Safe Handling and Use

Steps to be Taken in Case Material is Released or Spilled: Contain the spill to prevent a large discharge to surface streams or storm sewers. Since landfill operations will not accept liquid waste, allow to dry if possible before collecting for disposal. An absorbent material would aid in cleaning up a liquid spill. If liquid cleanup is necessary, collect in drums, buckets, or other containers.

Waste Disposal Method: The environmental concern is discoloration of land or water. If possible, the product should be dried before disposal. Disposal must be made in accordance with federal, state, and local regulation.

Precautions to be Taken in Handling and Storing: Local exhaust. Do not freeze. Avoid unnecessary skin contact. Do not breathe fumes.

Other Precautions: Eye wash fountains should be easily accessible. As with all chemicals, keep out of the reach of children.

Section VIII - Control Measures

Respiratory: If excessive vapors or mists are generated, wear NIOSH/MSHA approved organic vapor/mist respirator.

Ventilation: Use local exhaust to control excessive vapors/mists. If applicable, proper personal protection is a NIOSH/MSHA approved respirator.

Clothing: Gloves, coveralls, apron, boots as necessary to prevent skin contact as needed.

Eye: Chemical goggles; wear face shield if splashing hazard exists.

Other: Open wounds or skin surface disruptions should be covered with a chemical resistant patch to minimize absorption risks. Clean clothing should be worn daily to avoid possible long-term build up of the product leading to chronic overexposure.

Section IX - Shipping and Labeling Information

D.O.T. Shipping Data: Not regulated.

D.O.T. Hazard Classification NA

D.O.T. Labels Required: NA

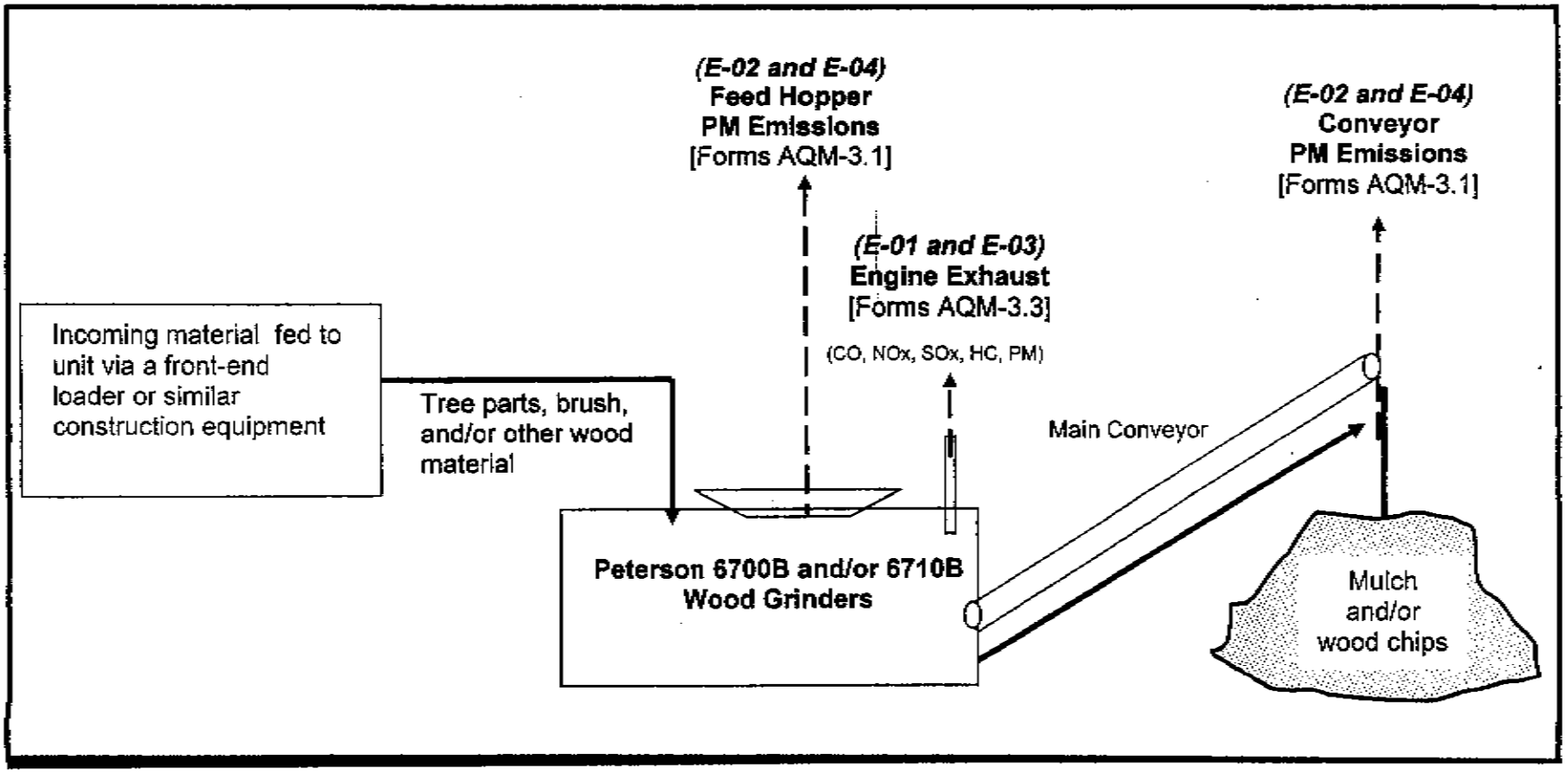
D.O.T. Identification NA

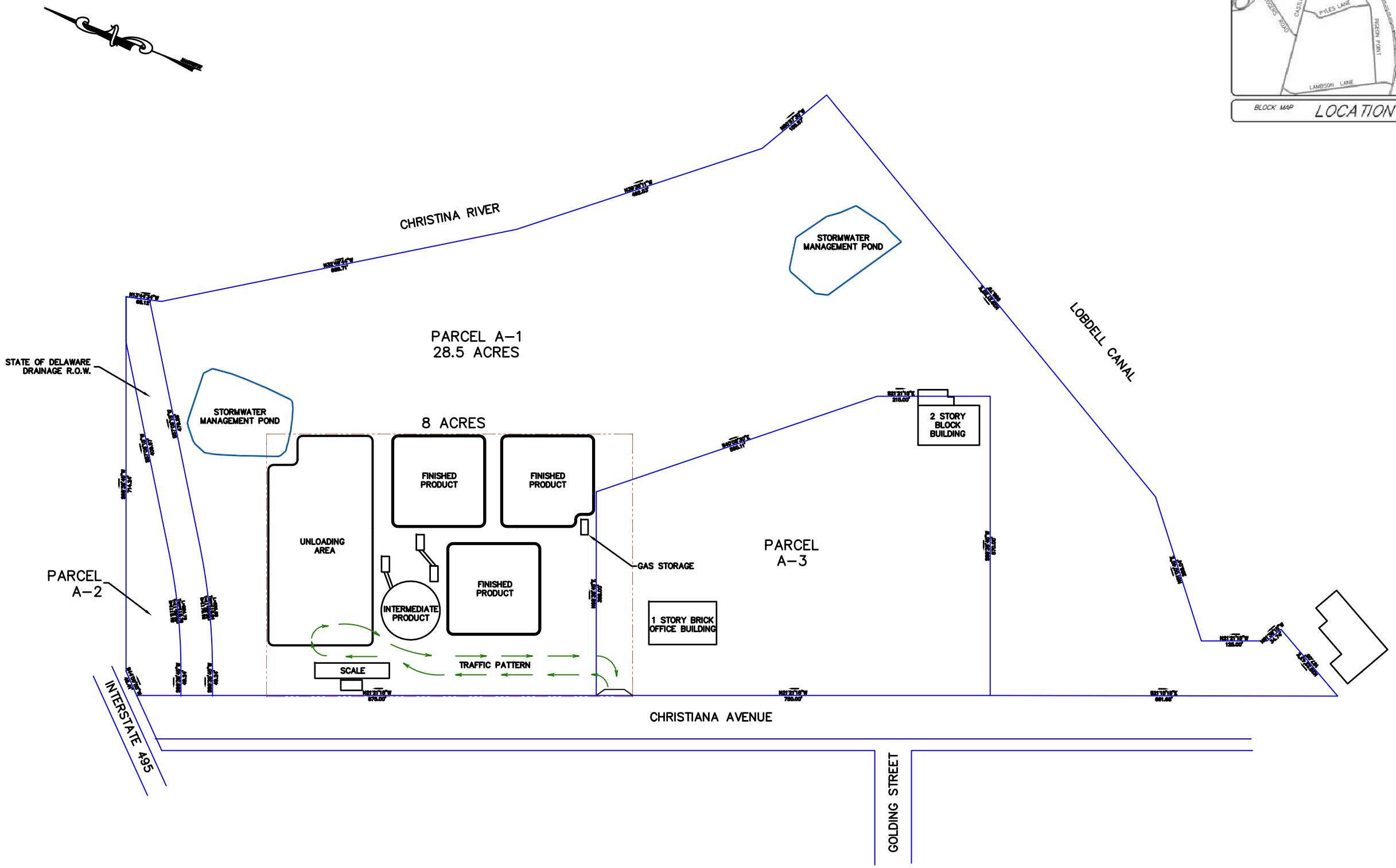
Section X - Disclaimer

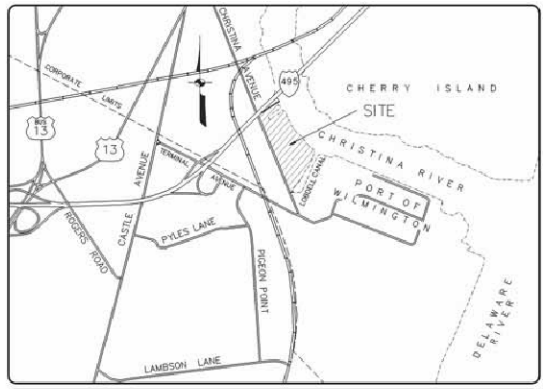
The opinions expressed herein are those of qualified persons with Becker Underwood, Inc. We believe the information contained here is current as of the date of this Material Safety Data Sheet. Since the use of this product is not within the control of Becker Underwood, Inc., it is the user's obligation to determine a safe end use of this product.

Process Flow Diagram

Sketch the Process Flow Diagram for the equipment or process being applied for. Include each emission unit and control device (even existing emission units that will not be modified by this application). You may identify each emission unit with a simple shape. Label each emission unit and control device with a unique identifier. Show the relationship between each emission unit and/or control device by drawing arrows between them to indicate the flow of air pollutants. List which application forms are included for each emission unit or control device below the shape representing each emission unit or control device . See http://www.delaware.gov/reg2/default.htm for example Process Flow Diagrams for common processes. If you already have a Process Flow Diagram for the equipment or process being applied for, you may attach it to the application instead of using this form.







NOTES:

1. BASE MAP INFORMATION TAKEN FROM A PLAN ENTITLED, "SITE PLAN–POTTS PROPERTY–CHRISTINA AVE", BY VANDEMARK AND LYNCH, INC. ON DECEMBER 16, 2005.

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)
1 inch = 100 ft.

NO.	DATE	BY	REVISIONS
1			

THOMAS G. PULLAR, P.E.

PREPARED FOR:
COMPLIANCE PLUS SERVICES, INC.

PREPARED BY:
ENVIRONMENTAL ENGINEERING and SCIENCE
EarthRes Group, Inc.
P.O. Box 468
7137 Old Easton Road
Pipersville, PA 18947 USA
www.earthres.com
215-766-1211
ERG
EARTHRES GROUP

SITE PLAN

2007 SITE WORK
YARD WASTE RECYLING FACILITY
CITY OF WILMINGTON, NEW CASTLE, DE

DRAWN BY: M.K.
CHECKED BY: TGP
DATE: 11/12/07
PROJECT NO: 011016.024
DRAWING NUMBER: D–001

STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES & ENVIRONMENTAL CONTROL
DIVISION OF FISH & WILDLIFE
NATURAL HERITAGE & ENDANGERED SPECIES
4876 HAY POINT LANDING ROAD
SMYRNA, DELAWARE 19977
TELEPHONE: (302) 653-2880
FAX: (302) 653-3431

May 18, 2007

Lynn Carre
c/o ALMA, LLC
529 Terminal Avenue
New Castle, DE 19720

RE: 601 Christiana Ave, Wilmington, Delaware
[redacted]
Applicant: Port Contractors, Inc.

Dear Ms. Carre:

Thank you for contacting the Natural Heritage and Endangered Species program about information on rare, threatened and endangered species, unique natural communities, and other significant natural resources as they relate to the above referenced project.

A review of our database indicates that there are currently no records of state-rare or federally listed plants, animals or natural communities at or adjacent to this project site that would be affected by project activities. According to our GIS database and aerial photographs there are freshwater wetlands and inter-tidal mudflat habitat on this property. Efforts to reduce impacts to these areas should be made, as they can serve as important habitat for some species of wildlife. To protect water quality, efforts should be made to minimize sedimentary or inputs of other materials into the Christina River during project operations. On-going efforts should also be made to contain run-off on-site so that it does not enter the River or associated wetlands.

We are continually updating records on Delaware's rare, threatened and endangered species, unique natural communities and other significant natural resources. If the start of the project is delayed more than a year past the date of this letter, please contact us again for the latest information. If you have any questions, please contact me at (302) 653-2883 ext. 126.

Sincerely,
Edna J. Stetzar
Edna J. Stetzar
Biologist/Environmental Review Coordinator

PROPOSED OFFSET PLAN

FOR

RECYCLABLE YARD MATERIAL FACILITY

The proposed recyclable yard material processing facility will provide a number of environmental benefits. These will include, but are not limited to:

- Removing a solid waste stream from Delaware's solid waste management system and producing a material that can be beneficially reused;
- Extending the life of Delaware's landfills thereby deferring the environmental impacts of construction and operation of newly permitted landfill space;
- Reduction in the use of landfill management, operating equipment and systems necessary to process and store wastes directed for landfill disposal, including but not limited to: loaders/compactors, other heavy equipment, stormwater management systems, leachate collection systems, and landfill gas management systems;
- Conservation of natural resources with the reduction in the use of mined new soils for daily, intermediate, final cover and landfill construction materials; and
- Improved aesthetics and quality of life issues for the landfill's surrounding community.

Currently, this solid waste material is managed at a number of landfills within the State of Delaware. For the purposes of this offsetting analysis, it has been assumed that material will be diverted from DSWA's Cherry Island Landfill and the DRPI Landfill units. This assumption has been made due to the proximity of the proposed facility to these landfill units facilitating the diversion of this source material based on no significant additional transportation costs.

The processing of recyclable yard material at the proposed facility will result in an increase in air emissions from the horizontal grinders and associated equipment used to produce the final product. This information is detailed in Section 5 of the Coastal Zone application and is further discussed below. Coastal zone permit regulations require the applicant to provide offsets which clearly and demonstrably are more beneficial to the environment in the Coastal Zone than the potentially harmful environmental impacts associated with the proposed activities that require permitting.

The proposed Offset Plan includes offsets in the reduction of direct and indirect media pollutants, positive enhancement of socio-economic impacts to the community and replenishment of natural resources that will provide an overall benefit to the Coastal Zone.

<u>Media Impact Offsets:</u>

This offsetting plan addresses the potential pollutant emissions from the processing operation including both air and stormwater runoff. Overwhelmingly, the principal pollutants emitted from the proposed facility relate to air emissions. Accordingly, we have focused this portion of the offset plan to address

the potential air emissions that would be avoided or saved as a result of the proposed processing operations that are planned for this facility.

As described above, the proposed facility is designed to take wood, leaves and grass clipping materials that are generated from yard maintenance from residential, commercial and industrial landscaping and management operations that are conducted throughout the state. This facility would also be accepting land clearing material (trees, branches, scrubs, etc.) that are amenable to mulching operations. The diversion of these materials to the proposed recycling facility to be manufactured into a reusable product will result in a reduction in the amount of this material that would have otherwise ended up at the Cherry Island or DRPI landfills (although we recognize that some land clearing materials are currently either buried or mulched directly onsite). It has been long recognized and studied that organic or carbon-containing wastes that are placed into landfill units naturally breakdown over time within the landfill unit. This breakdown process results in emissions of various potential pollutants, principally methane gas and carbon dioxide. Consequently, since the material processed at the proposed facility will no longer have to be managed at the landfills, there will be a net decrease in emissions associated with handling the material and general landfill operations. For the purposes of this offset plan, the emission "credits" that are discussed here have been developed based on the difference between the emissions generated from management in landfills as opposed to the proposed material management techniques that will be conducted at proposed facility.

To make the offsetting analysis inherently conservative, the following assumptions have been made:

1. The proposed facility will process approximately 100,000 TPY (tons per year) of material. This throughput has been used in the development of point source emissions from the facility. Further, certain types of material require additional processing. This is usually some percentage of the overall material stream accepted by the facility. Since there is no current basis for assessing the size of this material stream, it has been assumed that all material (i.e., the full 100,000 TPY) will require additional processing. That is, emissions have been developed as though the facility will be processing 200,000 TPY of material.

2. Offsets have been developed based on diverting approximately 50,000 TPY[1] of material (or processing approximately 100,000 TPY of material – i.e., processing 50,000 TPY of material through the facility twice). This is based on the assumption that all of the 45,000 tons per year of recyclable yard material that has been reported as being disposed into the local landfill identified here are sent to the proposed facility (particularly with the statewide imposed landfill ban on this material), and a total of 5,000 TPY of land clearing materials

Using the above assumptions, point source emissions from the proposed facility were calculated using a combination of equipment manufacturer's data and emission factors from US EPA, AP-42. These emissions are summarized in tabular form below. Detailed emissions calculations and information supporting these summary emissions are provided in Exhibit 2.

[1] DNREC Division of Air and Waste Management press release 03Nov06; Volume 36, Number 401. See Exhibit 1.

	Proposed Facility Emissions (TPY)			
Air Pollutant	Peterson 6708B	Peterson 6710B	Colorant Equipment	PTE w/ Permit Controls
PM	1.51	4.15	0.01	5.67
CO	0.38	0.39	0.07	0.84
NOx	4.16	3.08	0.86	8.10
SOx	0.18	0.19	1.91E-04	0.37
HC	0.05	0.07	0.03	0.15
TOTAL	***6.28***	***7.87***	***0.97***	***15.13***

As described above, the materials that will be processed at the proposed facility will result in a corresponding decrease in the amount of these materials being directed to the landfills for disposal.

We are using Delaware Solid Waste Authority's (DSWA) Cherry Island landfill as a typical landfill for the purposes of quantifying the offsets available. However, landfill operations do not differ substantially from location to location, therefore the amount of benefits from diverting recyclable yard material from landfill(s) will not change.

DSWA's 2006 Annual Report shows that Cherry Island Landfill accepted 643,100 tons of waste including recyclable yard material (See Exhibit 3). The ban on yard waste is estimated to divert 45,000 tons of waste materials per year from the Landfill (See Exhibit 4). An additional 5,000 tons of site clearing debris is also estimated to be diverted to the proposed facility each year.

The estimated 50,000 tons per year represents an approximate 7.8% of the total amount of waste being handled (compacted and covered) at the landfill. It is reasonable to assume that a 7.8 % reduction in volume will result in a corresponding reduction in the use of compaction equipment and the need for intermediate daily cover materials at the landfill.

The result of this reduction or diversion of the waste stream would have a positive impact on the environment in the Coastal Zone for the following reasons:

- There will be a reduction in the amount of time compaction equipment will be used at the landfill to compact 7.8% less waste material (thereby reducing the amount of engine combustion hours).
- The amount of intermediate daily cover materials required at the landfill would be reduced. The production of these materials requires either mining of virgin soils or the processing of other materials to provide the daily cover soils. This process normally involves various types of construction equipment such as loaders, screening equipment and vehicles to transport the material to the landfill site. The decreased amount of cover material will result in a reduction in construction equipment operating hours (not producing potentially harmful air emissions). We have used the DSWA 2006 Annual Report to estimate the amount of material used for intermediate daily cover required. The report shows that Clean Earth of New Castle, Inc. (CENC) provided approximately 471,000 tons of cover materials that year. Using the 7.8% factor used above to estimate the amount of cover material that would not

be required, we developed estimates of the air emissions that would have resulted from the processing and transport of approximately 33,000 tons of cover materials. If a source other than the CENC facility was utilized to provide the cover material, the amount of emissions would be very similar. See Exhibit 2 for detailed calculations.

A summary of the reduced emissions due to the reduced landfill operations is provided in the following table:

	Reduced Emissions from Landfill Operations (Tons per Year)					
Contaminant	Compactors	Loader (engines)	Material Handling	Screener Operation	Truck Transport	***Contaminant Totals***
Hours[1]	*568*	*216*	*N/A*	*163.0*	*771.6*	
PM	0.35	0.06	0.07	0.06	0.03	*0.56*
CO	1.05	0.19	N/A	5.50E-02	0.61	*1.91*
NOx	4.88	0.87	N/A	0.26	0.92	*6.92*
Sox	0.32	0.06	N/A	1.69E-02	0.00	*0.40*
HC	0.39	0.07	N/A	2.03E-02	0.04	*0.52*
Total Emissions	*6.98*	*1.25*	*0.07*	*0.41*	*1.6*	

A comparison between the increased air emissions at the proposed facility and the reduced air emissions at the landfill is summarized below:

	Emissions in Tons per Year			
Contaminant	Reduced Landfill Operations	Proposed Operations	Proposed @ 1.3X	Difference
PM	0.56	5.67	7.37	6.81
CO	1.91	0.84	1.09	-0.82
NOx	6.92	8.10	10.53	3.61
Sox	0.40	0.37	0.48	0.08
HC	0.52	0.15	0.20	-0.33
Total Emissions	*10.31*	*15.13*	*19.67*	*9.36*

Discussion of specific contaminants:

Particulate matter (PM): The proposed operations will result in an increase of particulate matter emissions above the recommended 1:1.3 rate. However, in general, the State of Delaware is in attainment with the National Air Quality Standards (NAAQS) for this criteria pollutant (Source: Delaware

Annual Air Quality Report 2006. See Exhibit 5) and the increased amount of emissions is not anticipated to affect this attainment status.

Carbon Monoxide (CO): The proposed operations will result in a decrease of CO above the recommended 1:1.3 rate.

Nitrogen Oxides (NOx): The proposed operations will result in an increase of NOx emissions above the recommended 1:1.3 rate. The equipment used to process the recyclable yard materials at the proposed facility will utilizes diesel engines to power the grinders and colorant equipment. This type of engine is needed to run the heavy mechanical grinders. The reduction in landfill operations discussed above partially offset the amount of NOx produced. The State of Delaware is in attainment with the National Air Quality Standards (NAAQS) for nitrogen dioxide (NO_2) (Source: Delaware Annual Air Quality Report 2006). NO_2 is part of the group of gases containing nitrogen and oxygen called oxides of nitrogen or NOx.

SOx: The proposed operations will result in a very slight increase of SOx above the recommended 1:1.3 rate. However, in general, the State of Delaware is in attainment with the National Air Quality Standards (NAAQS) for this criteria pollutant (Source: Delaware Annual Air Quality Report 2006) and the increased amount of emissions is not anticipated to affect this attainment status.

Greenhouse Gases

The overall environmental impact to the Coastal Zone is not limited to the above listed constituents. Although not listed as a criteria pollutant, Greenhouse Gases (GHG) which include carbon dioxide (CO_2) are of concern.

The amount of CO_2 emissions due to the various pieces of equipment (either in operation at the proposed facility or not in operation due to the deferral of waste materials at the landfill) can be estimated using US EPA A-42. Exhibit 2 contains the detailed calculations.

There is a significant positive impact to the environment related to not landfilling recyclable yard material. Processing of the recyclable yard material for re-use mitigates the production of greenhouses gases (GHG) from the degradation of materials inside the landfill.

The basis for quantification of the air emission offsets for the proposed project is the mitigation of greenhouse gases (GHG's) from processing the recyclable yard material as opposed to landfilling the material. That is, an estimate of metric tons of carbon dioxide equivalents ($MTCO_2Es$) has been developed. Our approach for this has been to utilize the US EPA's Waste Reduction Model (Or WARM) (See Exhibit 6). This model, which estimated the environmental benefits of alternate waste management scenarios, was first introduced in 1998. Over the past ten or so years, it has undergone a number of revisions the most recent in August, 2006 resulting in WARM version 8. This model is probably the best tool available to meaningfully compare the GHG impacts of alternate waste management scenarios.

WARM estimates net environmental benefits between select scenarios. The model allows the user to input numerous variables to tailor the results to specific circumstances. For the purpose of estimating the net benefits anticipated from the proposed project, the following assumptions have been made and placed into the model:

1. The recyclable yard material to be processed will consist of the following mixture: 50% grass; 25% leaves; and 25% branches. This ratio was extracted from a 1998 US EPA study[2] on GHG emissions. The material from land clearing operations will consist of 100% wood/branches.
2. The material would have normally gone to the Cherry Island or DRPI Landfills. For the purposes of this approach, we are assuming that both landfills will have gas collection and associated energy recovery systems operating at their facilities. Although we recognize that this is not in place yet, we have made the conservative assumption in the event that these systems are added in the future. Without these measures, the GHG emissions would be higher. The model assumes a collection percentage of 75% with the balance either remaining in the landfill or being released to the atmosphere as methane.
3. No impact is realized from transporting the material to the proposed facility versus the landfill. This approach was taken because, regardless of the material management method, transportation of the material will be required. However, 25 miles of transportation was included in the model to account for transportation of the finished material from the proposed facility to its end point of use.

Using the above assumptions for the estimated 50,000 tons of recyclable yard materials that will be processed (instead of being placed in the landfill) results in a reduction in GHG emissions of 22,612 $MTCO_2E$ (metric tons carbon dioxide equivalent).

As the table below illustrates, the overall impact of the deferral of recyclable yard material from the landfill to the proposed facility will result in a decrease of over 22,000 metric tons carbon dioxide equivalent.

	Emissions In Tons per Year			
Contaminant	Reduced Landfill Operations	Proposed Operations	Green House Gas Emissions Offsets ($METCO_2E$) per EPA WARM Model	Difference
CO2	-422.39	778.73	-22,612	-22,255.66

Although there is not, currently, a means to correlate the relative environmental benefits of mitigating criteria air pollutants versus greenhouse gases, the impacts of GHG is becoming increasingly well understood. Despite the assumption that the landfilling operation of recyclable yard material will include the collection of methane gas for energy recovery, there is still a significant amount of methane that would be released. Methane, a naturally occurring byproduct of anaerobic decomposition of organic matter, is a powerful greenhouse gas with a global warming potential 21 times greater than equivalents. The deferral of recyclable yard material from landfills will have a positive impact on the Coastal Zone for this fact alone.

Socio-economic Impacts

The proposed operation will also provide a positive impact on the Coastal Zone in other aspects. At current disposal rates, the Cherry Island Landfill is expected to reach its terminal height in 2025. The deferral of recyclable yard material from the landfill in 2008 has been forecast to add an additional seven years to its life (Source: DNREC Solid and Hazardous Waste Management Branch). The cost of identifying a site for the next municipal solid waste landfill and the associated permitting costs (which will be borne by the citizens of the State) will be likewise deferred.

Equally important is the fact that the proposed facility will be a "resource conservation" center. The recycled material produced will provide a positive environmental impact as it will be used to assist Delaware residents in landscaping and gardening efforts by improving air circulation and drainage, moderating soil temperatures, enhancing nutrient and water holding capacities, decreasing erosion, inhibiting weed growth and suppressing some plant pathogens.

Natural Resources Conservation

The proposed facility is, by the very nature of its operations, dedicated to improving the environment within the Coastal Zone. As demonstrated above, the proposed facility will provide Delaware residents and companies a convenient way of recycling a former waste stream into a useable product that will provide continuing benefits to the environment throughout the State.

In addition, the proposed facility is committed to contributing to the improvement of the local area. The location of the proposed facility on Christiana Avenue is close to the South Wilmington area of the City of Wilmington, DE. The revitalization of South Wilmington is being addressed by the development of a Special Area Management Plan (SAMP). A comprehensive action plan is being developed by a Core Management Team which oversees the efforts of several workgroups working on various SAMP components.

In October 2007, a Wetland & Hydrologic Assessment Summary Report was issued (See Exhibit 7). The South Wilmington area contains a 27 acre wetland area located between Walnut Street, A Street, S. Buttonwood Street and Garasches Lane. The report provides recommendations on wetland restoration efforts. A list of future needs includes steps required to determine the best way to increase water connectivity between the wetlands and the Christina River.

The applicant is proposing a financial contribution of $2,500.00 to assist in the implementation of the recommendations of the Wetland & Hydrologic Assessment Summary Report

List of Exhibits

Exhibit 1	Delaware Natural Resources and Environmental Conservation Press Release 03 Nov 2007 Volume 36 Number 401
Exhibit 2	Detailed Emissions Calculations
Exhibit 3	Delaware Solid Waste Authority Annual Report 2006
Exhibit 4	Delaware Natural Resources and Environmental Conservation (DNREC) News December 6, 2006 Volume 36 Number 434
Exhibit 5	Delaware Annual Air Quality Report 2006.
Exhibit 6	Calculating Greenhouse Gas Emissions with the Waste Reduction Model (US EPA User's Guide for WARM) (www.epa.gov/climatechange/wycd/waste/calcualtors/Warm_UserGuide.html)
Exhibit 7	South Wilmington Special Area Management Plan Summary Report Wetlands & Hydrologic Assessment Summary Report

Applicant: Alma Properties, LLC
Project: Recyclable Yard Material Facility, 601 Christiana Avenue, Wilmington, DE
Application Date:
CZA Offset Review Reference: (DNREC Only)

COASTAL ZONE ENVIRONMENTAL IMPACT OFFSET MATRIX

Amendments:
Offset Review Date: (DNREC Use Only)
Matrix Amended:

ENVIRONMENTAL IMPACTS	(Applicant's Use) DESCRIBE ENVIRONMENTAL IMPACTS	PAGE NO.	(Applicant's Use) DESCRIBE ENVIRONMENTAL OFFSET PROPOSAL[1]	PAGE NO.	(DNREC Use Only) OFFSET SUFFICIENCY Yes, No or N/A
Air Quality (Applicant to List Below by Parameter)		pp. 11			
NOx	Estimated increase of 8.10 tons per year.	11	Estimated decrease of 6.92 tons per year (due to reduced equipment usage at landfills and reduced need for intermediate daily cover materials at landfills).	See Proposed Offset Plan for Recyclable Yard Material Facility (Attachment G)	
SO2	Estimated increase of 0.37 tons per year.	11	Estimated decrease of 0.40 tons per year (due to reduced equipment usage at landfills and reduced need for intermediate daily cover materials at landfills).		
CO	Estimated increase of 0.84 tons per year.	11	Estimated decrease of 1.91 tons per year (due to reduced equipment usage at landfills and reduced need for intermediate daily cover materials at landfills).		
PM	Estimated increase of 5.67 tons per year.	11	Estimated decrease of 0.56 tons per year (due to reduced equipment usage at landfills and reduced need for intermediate daily cover materials at landfills).		
VOCs	Estimated increase of 0.15 tons per year.	11	Estimated decrease of 0.52 tons per year (due to reduced equipment usage at landfills and reduced need for intermediate daily cover materials at landfills).		
CO_2			The deferral of recyclable yard material from the landfill to the proposed facility will result in a decrease of over 22,000 metric tons carbon dioxide equivalent per year.	See Proposed Offset Plan (Attachment G)	
Water Quality					
Surface	No impact.	pp. 12-15			
Groundwater	No impact	pp 12-15			
Water Quantity					
Surface	No impact	15-16			
Groundwater	No impact	15-16			
Water Use For:					
Processing	No impact	15-16			
Cooling	No impact	15-16			
Effluent Removal	No impact	15-16			
Solid Waste	No impact	16	The proposed facility will divert approximately 50,000 tons of materials per year from being processed at landfills therefore extending the life of the landfill.	See Proposed Offset Plan (Attachment G)	
Hazardous Waste	No impact	17			
Habitat					
Wetlands	No impact	17-18	The applicant is proposing a financial contribution of $2500 to assist in the implementation of the recommendations of the Wetlands & Hydrologic Assessment Summary Report of the South Wilmington Special Area Management Plan (SAMP) (October 2007)		
Flora Fauna	No impact	17-18			
Drainage/Flood Control	Existing storm water detention basin is of adequate size to handle 100 year, 24 hour storm event	17			
Erosion[2]	No impact				
Land Use Effects					
Glare	No impact	pp. 18-19			
Heat	No impact	pp. 18-19			
Noise	No impact	pp. 18-19			
Odors	No impact	pp. 18-19			
Vibration	No impact	pp. 18-19			
Radiation	No impact	pp. 18-19			
Electro-Magnetic Interference	No impact	pp. 18-19			
Other Effects	None	pp. 18-19			
Threatened & Endangered Species	No impact.	18			
Impacts From:					
Raw Material	Not applicable.				
Intermediate Products	Not applicable.				
By-Products	Not applicable.				
Final Products	Not applicable				

EXHIBIT 2

DETAILED EMISSIONS CALCULATIONS

Exhibit 2-1

Emissions Calculations for FSGR Operations

Recyclable Facility-wide Potential to Emit (PTE) Calculations

Pollutant	Peterson 6700B[1]	Peterson 6710B[2]	Colorbiotics Sahara X1 Colorant Equipment[3]		
	lbs/hr	lbs/hr	lbs/hr		
PM	2.80	2.77	0.02		
CO	0.77	0.79	0.13		
NOx	8.32	6.16	1.72		
SOx	0.37	0.37	0.00		
HC	0.10	0.14	0.06		
CO_2	1495.80	1331.60	143.75		
	tons/yr	tons/yr	tons/yr	PTE w/ Permit Controls[1,2] tons/yr	PTE w/o Permit Controls[4] tons/yr
PM	1.51	4.15	0.01	5.67	24.48
CO	0.38	0.39	0.07	0.84	7.36
NOx	4.16	3.08	0.86	8.10	70.93
SOx	0.18	0.19	0.00	0.37	3.25
HC	0.05	0.07	0.03	0.15	1.29
CO_2	373.95	332.90	71.88	778.73	13013.64
TOTAL (TONS/YR)	***380.23***	***340.77***	***72.84***	***793.85***	***13120.94***

Notes

[1] PTE for Peterson 6700B based on Operating at Full Load (100%) for 50% of total operating time and Idle (10%) for 50% of the total operating time; Total Operating hrs/yr - 1000

[2] PTE for Peterson 6710B based on Operating at Full Load (100%) for 50% of total operating time and Idle (10%) for 50% of the total operating time; Total Operating hrs/yr - 1000

[3] PTE for Colorbiotics X1 based on total operating hours of 1000 hrs/yr.

[4] PTE based on using no limit/restrictions on operations of each unit (8760 hrs/yr)

Assumptions

Full Load - 100%
Idle - 10%
Normal operation of the grinder units is considered to be operating at Full Load for 50% and Idle for 50% of the total operating time.

Recyclable Yard Material Facility, Peterson 6700B Wood Grinder Emissions

Equipment	Max Output	PM Emissions[1] Based on 1000 HP at Full Load (100%)		CO Emissions[1] Based on 1000 HP at Full Load (100%)	NOx Emissions[1] Based on 1000 HP at Full Load (100%)	SOx Emissions[3] Based on 1000 HP at Full Load (100%)	HC Emissions[1] Based on 1000 HP at Full Load (100%)	CO_2 Emissions[2] Based on 1000 HP at Full Load (100%)
		PM 10[4]	PM					
Caterpillar 3412E Diesel Engine	1,000 HP	0.15 lb/hr	0.15 lb/hr	0.79 lb/hr	15.00 lb/hr	0.37 lb/hr	0.08 lb/hr	1273.30 lb/hr
	749 kW	75.00 lb/yr	75.00 lb/yr	395.00 lb/yr	7,500 lb/yr	184 lb/yr	40.00 lb/yr	636,650.00 lb/yr
	500 hrs/yr	0.04 ton/yr	0.04 ton/yr	0.20 ton/yr	3.75 ton/yr	0.09 ton/yr	0.02 ton/yr	318.33 ton/yr
Emission Point E-01								

Equipment	Idle Output[2]	PM Emissions[2] Based on 1000 HP at Idle (10% Load)		CO Emissions[2] Based on 1000 HP at Idle (10% Load)	NOx Emissions[2] Based on 1000 HP at Idle (10% Load)	SOx Emissions[3] Based on 1000 HP at Idle (10% Load)	HC Emissions[2] Based on 1000 HP at Idle (10% Load)	CO_2 Emissions[2] Based on 1000 HP at Full Load (100%)
		PM 10[4]	PM					
Caterpillar 3412E Diesel Engine	100 HP	0.05 lb/hr	0.05 lb/hr	0.74 lb/hr	1.63 lb/hr	0.37 lb/hr	0.11 lb/hr	222.50 lb/hr
	75 kW	25.00 lb/yr	25.00 lb/yr	370.00 lb/yr	815 lb/yr	184 lb/yr	55.00 lb/yr	111,250.00 lb/yr
	500 hrs/yr	0.01 ton/yr	0.01 ton/yr	0.19 ton/yr	0.41 ton/yr	0.09 ton/yr	0.03 ton/yr	55.63 ton/yr
Emission Point E-01								

Totals	*1000 hrs/yr*	***0.10*** *lb/hr*	***0.10*** *lb/hr*	***0.77*** *lb/hr*	***8.32*** *lb/hr*	***0.37*** *lb/hr*	***0.10*** *lb/hr*	***1495.80*** *lb/hr*
		0.05 *ton/yr*	***0.05*** *ton/yr*	***0.38*** *ton/yr*	***4.16*** *ton/yr*	***0.18*** *ton/yr*	***0.05*** *ton/yr*	***373.95*** *ton/yr*

Equipment	Max Output[6]	PM Emissions[6]		Engine and Tub Grinder Total PM Emissions	
		PM 10[4]	PM	PM 10[4]	PM
Peterson 6700B Wood Grinder	1080 hrs/yr	1.44E-02 lb TSP/ton	2.40E-02 lb TSP/ton	1.72 lb/hr	2.80 lb/hr
	625 yd/hr	1.62 lb/hr	2.70 lb/hr	1,857.60 lb/yr	3,024.00 lb/yr
	112.5 ton/hr	1,749.60 lb/yr	2,916.00 lb/yr	**0.93** ton/yr	**1.51** ton/yr
Emission Point E-02		0.87 ton/yr	1.46 ton/yr		

747.90

Notes:

[1] Based on Caterpillar emissions engine test data operating at full load (in lb/hr) supplied by Ransome Equipment (Authorized Caterpillar Dealer)

[2] Based on Caterpillar emissions engine test data operating at idle (10% load, in lb/hr) supplied by Ransome Equipment (Authorized Caterpillar Dealer)

[3] SOx estimate based on fuel consumption data (in gal/hr) supplied by Ransome Equipment at 0.05% maximum sulfer content of diesel fuel.

[4] Conversion Factor for Particulate Matter: PM 10 = PM/2.1 (based on 1/95 version of AP-42 Table 11.19.2-2.

[5] Conversion Factor for Wood Processing: 0.18 tons/yd of wood (mixed/other) [EPA Waste Generation Calculations, Appendix C]

[6] Emission factors based on previous publication of AP-42, Table 10.3.1 referenced in permitting handbook article by M.K. Carol Lee, July 18, 2006. Basis - TSP/ton wood processed. *(http://www.baaqmd.gov/pmt/handbook/rev02/PH_00_05_11_13.pdf)*

[7] Caterpillar 3412 E engine is Tier I Certified by the Environmental Protection Agency.

Assumptions:

1 g = 0.002205 lbs
1 gal of Diesel Fuel = 7.2 lbs
Total Hours per year = 1080
Grinder Max Output = 1000 HP or 749 kW
Max Sulfur Content of Diesel Fuel = 0.05%
Fuel Consumption = 51gal/hr

Rev. 1, May 23, 2007

Emission factors based on AP-42, Table 11.19.2-2

Recyclable Yard Material Facility, Peterson 6710B Wood Grinder Emissions

Equipment	Max Output[1]	PM Emissions[1] Based on 1050 HP at Full Load (100%)		CO Emissions[1] Based on 1050 HP at Full Load (100%)	NOx Emissions[1] Based on 1050 HP at Full Load (100%)	SOx Emissions[1] Based on 1050 HP at Full Load (100%)	HC Emissions[1] Based on 1050 HP at Full Load (100%)	CO_2 Emissions[1] Based on 1000 HP at Full Load (100%)
		PM 10[4]	PM					
Caterpillar C27 Diesel Engine	1050 HP	0.06 lb/hr	0.06 lb/hr	0.59 lb/hr	10.38 lb/hr	3.74E-01 lb/hr	0.12 lb/hr	1139.00 lb/hr
	786 kW	30.00 lb/yr	30.00 lb/yr	295.00 lb/yr	5,190 lb/yr	187 lb/yr	60.00 lb/yr	569,500.00 lb/yr
	500 hrs/yr	0.02 ton/yr	0.02 ton/yr	0.15 ton/yr	2.60 ton/yr	0.09 ton/yr	0.03 ton/yr	284.75 ton/yr
Emission Point E-03								

Equipment	Idle Output[2]	PM Emissions[2] Based on 1050 HP at Idle (10% Load)		CO Emissions[2] Based on 1050 HP at Idle (10% Load)	NOx Emissions[2] Based on 1050 HP at Idle (10% Load)	SOx Emissions[3] Based on 1050 HP at Idle (10% Load)	HC Emissions[2] Based on 1050 HP at Idle (10% Load)	CO_2 Emissions[1] Based on 1000 HP at Full Load (100%)
		PM 10[4]	PM					
Caterpillar C27 Diesel Engine	105 HP	0.07 lb/hr	0.07 lb/hr	0.98 lb/hr	1.94 lb/hr	3.74E-01 lb/hr	0.15 lb/hr	192.60 lb/hr
	79 kW	35.00 lb/yr	35.00 lb/yr	490.00 lb/yr	970 lb/yr	187 lb/yr	75.00 lb/yr	96,300.00 lb/yr
	500 hrs/yr	0.02 ton/yr	0.02 ton/yr	0.25 ton/yr	0.49 ton/yr	0.09 ton/yr	0.04 ton/yr	48.15 ton/yr
Emission Point E-03								

Totals	*1000 hrs/yr*	*0.07 lb/hr*	*0.07 lb/hr*	*0.79 lb/hr*	*6.16 lb/hr*	*0.37 lb/hr*	*0.14 lb/hr*	*1331.60 lb/hr*
		0.03 ton/yr	*0.03 ton/yr*	*0.39 ton/yr*	*3.08 ton/yr*	*0.19 ton/yr*	*0.07 ton/yr*	*332.90 ton/yr*

Equipment	Max Output[5]	PM Emissions[6]		Engine and Tub Grinder Total PM Emissions	
		PM 10[4]	PM	PM 10[4]	PM
Peterson 6710B Wood Grinder	3000 hrs/yr	1.44E-02 lb TSP/ton	2.40E-02 lb TSP/ton	1.69 lb/hr	2.77 lb/hr
	625 yd/hr	1.62 lbs/hr	2.70 lbs/hr	5,055.00 lb/yr	8,295.00 lb/yr
	112.5 ton/hr	4,860.00 lb/yr	8,100.00 lb/yr	2.53 ton/yr	4.15 ton/yr
Emission Point E-04		2.43 ton/yr	4.05 ton/yr		

Notes:

[1] Based on Caterpillar emissions engine test data operating at full load (in lb/hr) supplied by Ransome Equipment (Authorized Caterpillar Dealer)

[2] Based on Caterpillar emissions engine test data operating at idle (10% load, in lb/hr) supplied by Ransome Equipment (Authorized Caterpillar Dealer)

[3] SOx estimate based on fuel consumption data (in gal/hr) supplied by Ransome Equipment at 0.05% maximum sulfer content of diesel fuel.

[4] Conversion Factor for Particulate Matter: PM 10 = PM/2.1 (based on 1/95 version of AP-42 Table 11.19.2-2.

[5] Conversion Factor for Wood Processing: 0.18 tons/yd of wood (mixed/other) [EPA Waste Generation Calculations, Appendix C]

[6] Emission factors based on previous publication of AP-42, Table 10.3.1 referenced in permitting handbook article by M.K. Carol Lee, July 18, 2006. Basis - TSP/ton wood processed. *(http://www.baaqmd.gov/pmt/handbook/rev02/PH_00_05_11_13.pdf)*

[7] Caterpillar C27 engine is Tier II Certified by the Environmental Protection Agency.

Assumptions:

1 g = 0.002205 lbs
1 gal of Diesel Fuel = 7.2 lbs
Total Hours per year = 3000
Grinder Max Output = 1000 HP or 749 kW
Max Sulfur Content of Diesel Fuel = 0.05%
Fuel Consumption = 52 gal/hr

Rev. 1, May 23, 2007

Recyclable Yard Material Facility, Colorbiotics Sahara X1 Colorant Equipment

Equipment	Max Output	PM Emissions[1]		CO Emissions[1]	NOx Emissions[1]	SOx Emissions[2]	HC Emissions[1]	CO_2 Emissions[3]
		Based on information from Cummins		Based on information from Cummins	Based on information from Cummins	Based on Fuel Consumption data	Based on information from Cummins	Based on calculations from USEPA AP-42
Cummins B3.9-C Diesel Engine	125 HP 94 kW 1000 hrs/yr	PM 10[4]	PM					
		0.12 g/kw-hr	0.12 g/kw-hr	0.63 g/kw-hr	8.33 g/kw-hr	0.38 lb/bhp-hr	0.31 g/kw-hr	1.15 lb/hp-hr
		0.02 lb/hr	0.02 lb/hr	0.13 lb/hr	1.72 lb/hr	3.81E-04 lb/hr	0.06 lb/hr	143.75 lb/hr
		11.31 lb/yr	23.74 lb/yr	130.06 lb/yr	1,720 lb/yr	3.81E-01 lb/yr	64.00 lb/yr	143,750.00 lb/yr
		0.01 ton/yr	0.01 ton/yr	0.07 ton/yr	0.86 ton/yr	1.91E-04 ton/yr	0.03 ton/yr	71.88 ton/yr

Exhibit 2-2

Emissions Calculations for Deferred Landfill Operations and Reduced Need for Daily Cover

REDUCED OPERATIONS AT LANDFILL & REDUCED NEED FOR DAILY COVER MATERIAL

Emission Summary

Contaminant	Compactors	Loader (engines)	Material Handling	Screener Operation	Truck Transport	*Contaminant Totals*
Hours[1]	*568*	*216*	*N/A*	*163.0*	*771.6*	
PM	0.35	0.06	0.07	0.06	0.03	*0.56*
CO	1.05	0.19	N/A	5.50E-02	0.61	*1.91*
NOx	4.88	0.87	N/A	0.26	0.92	*6.92*
SOx	0.32	0.06	N/A	1.69E-02	0.00	*0.40*
HC	0.39	0.07	N/A	2.03E-02	0.04	*0.52*
CO2	180.89	32.39	N/A	9.46	199.65	*422.39*
Total Emissions	*187.87*	*33.64*	*0.07*	*9.87*	*201.25*	
					Combined Emissions:	***432.70***

1). Hours for compactors are based on estimated percentage of annual operating hours dedicated to the management of yard waste and wood waste that will be diverted from the landfill solid waste stream. Hours for remaining equipment is based on assumed reduction in intermediate/daily cover needs due to the divergence of wood/yard wastes from landfill disposal.

Caterpillar 836H Soil Compactor (2 units)

Equipment	Max Output	PM Emissions	CO Emissions[1]	NOx Emissions[1]	SOx Emissions[1]	HC Emissions[1]	CO2 Emissions[1]
Caterpillar C18 ACERT Diesel Engine	554 HP 415 kW 3640 hrs/yr[3]	2.20E-03 lb/hp-hr	6.68E-03 lb/hp-hr	0.03 lb/hp-hr	2.05E-03 lb/hp-hr	2.47E-03 lb/hp-hr	1.15 lb/hp-hr
		1.22 lb/hr	3.70 lb/hr	17.17 lb/hr	1.14 lb/hr	1.37 lb/hr	637.10 lb/hr
		4,436.43 lb/yr	13,470.62 lb/yr	62,513.36 lb/yr	4,133.95 lb/yr	4,980.90 lb/yr	2.32E+06 lb/yr
		2.22 tpy	6.74 tpy	31.26 tpy	2.07 tpy	2.49 tpy	1159.52 tpy
		4.44 Total tpy[4]	13.47 Total tpy[4]	62.51 Total tpy[4]	4.13 Total tpy[4]	4.98 Total tpy[4]	2319.04 Total tpy[4]
		0.35 7.8% total[5]	1.05 7.8% total[5]	4.88 7.8% total[5]	0.32 7.8% total[5]	0.39 7.8% total[5]	180.89 7.8% total[5]

Notes:

1). Emissions data based on AP-42, Table 3.3.

2). PM10 emissions are assumed to equal PM as test data for PM10 is not available.

3). Operating hours based on the landfills normal acceptance hours (M-F 7am to 5pm, Sat 7am to 3pm). Two (2) hours were added each day for the normal operations of the soil compacting equipment.

4). Total tons per year reflects the assumption that a total of two (2) soil compactor units will be operating simultaneously.

5).

7.8% Total represents the percentage of the total landfill material accepted that will be diverted from the landfills due to the ban of yard waste and wood waste.

Caterpillar 966H Loader Emissions

Equipment	Max Output[1]	PM Emissions	CO Emissions[1]	NOx Emissions[1]	SOx Emissions[1]	HC Emissions[1]	CO2 Emissions[2]
Caterpillar C18 ACERT Diesel Engine	262 HP	2.20E-03 lb/hp-hr	6.68E-03 lb/hp-hr	0.03 lb/hp-hr	2.05E-03 lb/hp-hr	2.47E-03 lb/hp-hr	1.15 lb/hp-hr
	196 kW	0.58 lb/hr	1.75 lb/hr	8.12 lb/hr	0.54 lb/hr	0.65 lb/hr	301.30 lb/hr
	108 hrs/yr	61.96 lb/yr	188.14 lb/yr	873.12 lb/yr	57.74 lb/yr	69.57 lb/yr	32,389.75 lb/yr
		0.03 tpy	0.09 tpy	0.44 tpy	0.03 tpy	0.03 tpy	16.19 tpy
		0.06 Total tpy	0.19 Total tpy	0.87 Total tpy	0.06 Total tpy	0.07 Total tpy	32.39 Total tpy

Notes:

1). Emissions data based on AP-42, Table 3.3.

2). PM10 emissions are assumed to equal PM as test data for PM10 is not available.

3). Operating hours based on the landfills normal acceptance hours (M-F 7am to 5pm, Sat 7am to 3pm). Two (2) hours were added each day for the normal operations of the soil compacting equipment.

4). Total tons per year reflects the assumption that a total of two (2) soil compactor units will be operating simultaneously.

Assumptions:

36562.12	Total amount of material processed (tons)
4.25	tons/loader bucket
8602.85	number of buckets required
0.01	Time/bucket (hours) (45 seconds)
107.54	Total hours per loader
215.07	Total hours (2 loaders)

Emissions from Material Handling

Loader Drop

Pollutant	Silt Content[1] (%)	Moisture Content[2] (%)	k	U[3] (mph)	Emission Factor (lb/ton)[4]	Throughput[5] (ton/drop)	Maximum emissions (lb/drop)	Number of Drop Pointsper truckload[5]	Maximum Emissions[4] (ton/load)	Maximum Annual Emissions (ton/yr) Total
PM[(b)]	9	7	0.74	9	0.00088	4.5	3.96E-03	15	2.97E-05	0.06

Truck Drop

Pollutant	Silt Content[1] (%)	Moisture Content[2] (%)	k	U[3] (mph)	Emission Factor (lb/ton)[4]	Throughput[5] (ton/drop)	Maximum emissions (lb/drop)	Number of Drop Points per truckload	Maximum Emissions[4] (ton/load)	Maximum Annual Emissions (ton/yr) Total
PM[(b)]	9	7	0.74	9	0.00088	22	1.94E-02	1	9.68E-06	0.02

Total Material Handling

Pollutant	Maximum Annual
PM[(b)]	0.07 ton/yr

Assumptions:

522,316.00 Landfill cover supplied by Clean Earth (tons)
40,740.65 Amount eliminated due to yard waste ban, assuming 7.8% yard waste
22 Tons/truck
1,852 Truck trips/year
4.4 miles from CENC to Cherry Island and back (round trip)
15 minutes per trip

Notes:

1). Silt content based upon USEPA AP-42, Table 13.2.4-1 (Rev. 11/06).
2). Moisture content obtained from Clean Earth of New Castle, Inc., based upon the average moisture content of the landfill cover supplied to Cherry Island.
3). Average wind speed based upon National Climatic Data Center information for Wilmington, DE, located at http://lwf.ncdc.noaa.gov/oa/climate/online/ccd/avgwind.html
4). Emission factor based upon USEPA AP-42 Section 13.2.4-4 (Rev. 11/06).
5). Number of drop points- it is assumed that, utilizing a four (4) cy bucket, it will take five (5) buckets to fill the truck (~22 tons). Thus, a total of 15 drops are assumed for 1). 5 loads from processing point to stockpile, 2). 5 loads from stockpile to truck, 3). 5 loads at the landfill from the truck drop point to the relocated point.

Extec S-5 Screener

Equipment	Max Output[1]	PM Emissions[1]	CO Emissions[1]	NOx Emissions[1]	SOx Emissions[1]	HC Emissions[1]	CO2 Emissions[1]
Deutz BF4M 2012 Diesel Engine[7]	101 HP	2.20E-03 lb/hp-hr	0.01 lb/hp-hr	0.031 lb/hp-hr	2.05E-03 lb/hp-hr	2.47E-03 lb/hp-hr	1.15 lb/hp-hr
	75 kW	2.22E-01 lb/hr	6.75E-01 lb/hr	3.13E+00 lb/hr	2.07E-01 lb/hr	2.49E-01 lb/hr	1.16E+02 lb/hr
	162.96 hrs/yr[3]	36.21 lb/yr	109.95 lb/yr	510.23 lb/yr	33.74 lb/yr	40.65 lb/yr	18927.80 lb/yr
		1.81E-02 ton/yr	**5.50E-02** ton/yr	**0.26** ton/yr	**1.69E-02** ton/yr	**2.03E-02** ton/yr	**9.46** ton/yr

Equipment	Max Output[5]	Controlled PM Emissions[2]
		PM
Extec S-5 screener	162.96 hrs/yr[3]	1.80E-03 lb/ton[2]
	250 ton/hr	0.45 lb/hr
		73.33 lb/yr
		0.04 ton/yr

Equipment	Max Output[5]	Controlled PM Emissions[2]
		PM
Extec Conveyor Discharge	162.96 hrs/yr[3]	7.00E-05 lb/ton[2]
	250 ton/hr	0.02 lb/hr
		2.85 lb/yr
		1.43E-03 ton/yr

Total PM Emissions
0.24 lb/hr
112.39 lb/yr
0.06 ton/yr

Notes:

1). Emission factors from engine are based upon USEPA AP-42 Table 3.3-1 (Rev. 10/96).

2). Emission factors for the screener and the discharge conveyor are based upon USEPA AP-42, Table 11.19.2-2 (Rev. 8/04).

3). Annual operation of screener based upon the assumption that 8% of the total material accepted by the landfill will now be diverted to other locations due to the landfill ban on yard waste and wood waste materials.

Caterpillar C15 Truck Engine Emissions

Equipment	Max Output[1]	PM Emissions[1]	CO Emissions[1]	NOx Emissions[1]	SOx Emissions[2]	HC Emissions[1]	CO2 Emissions[3]
Caterpillar C15 ACERT Diesel Engine	450 HP	7.00E-02 g/hp-hr	1.60 g/hp-hr	2.40 g/hp-hr	166.00 lb/hr fuel	0.10 g/hp-hr	1.15 lb/hp-hr
	337 kW	0.07 lb/hr	1.59 lb/hr	2.38 lb/hr	4.98E-03 lb/hr	0.10 lb/hr	517.50 lb/hr
		53.59 lb/yr	1,225.00 lb/yr	1,837.50 lb/yr	3.84 lb/yr	76.56 lb/yr	399,304.65 lb/yr
	771.6 hrs/yr	0.03 tpy	0.61 tpy	0.92 tpy	1.92E-03 tpy	0.04 tpy	199.65 tpy

Notes:

1). Emissions data obtained from testing conducted by California Air Resources Board for the Caterpillar C-15 on-highway engine, Executive Order A-013-0186

2). SOx emissions estimate based upon fuel usage, obtained from California Air Resources Board.

3). SOx emissions estimate based upon fuel usage, obtained from California Air Resources Board.

4). PM10 emissions are assumed to equal PM as test data for PM10 is not available.

Assumptions:

522316	Landfill cover supplied by Clean Earth (tons)
40740.6	Amount eliminated due to yard waste ban, assuming 7% yard waste
22	Tons/truck
1852	Truck trips/year
4.4	miles from CENC to Cherry Island and back (round trip)
15	minutes per trip
25	total minutes
771.603	total hours

Exhibit 2-3

WARM Model – Comparison of Landfill vs.

Mulching Operations

GHG Emissions Analysis -- Summary Report

Version 7 (5/05)
GHG Emissions Waste Management Analysis for
Prepared by:
Project Period for this Analysis: 01/00/00 to 01/00/00

GHG Emissions from Baseline Waste Management ($MTCO_2E$): (32,517)

Commodity	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted	Total $MTCO_2E$
Grass	NA	22,500	-	-	(4,870)
Leaves	NA	11,250	-	-	(12,397)
Branches	NA	18,250	-	-	(15,445)

GHG Emissions from Alternative Waste Management Scenario ($MTCO_2E$): (9,905)

Commodity	Tons Source Reduced	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted	Total $MTCO_2E$
Grass	NA	NA	-	-	22,500	(4,457)
Leaves	NA	NA	-	-	11,250	(2,220)
Branches	NA	NA	-	-	18,250	(3,210)

Total Change in GHG Emissions: **22,612 $MTCO_2E$**

This is equivalent to...		
Removing	(4,894)	Passenger Cars from the Roadway Each Year

Note: a negative value (i.e., a value in parentheses) indicates an emission reduction; a positive value indicates an emission increase.

a) For explanation of methodology, see the EPA report:
Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks (EPA530-R-02-006)
-- available on the Internet at http://www.epa.gov/mswclimate/greengas.pdf (1.1 Mb PDF file).

WAste Reduction Model (WARM) -- Inputs

Use this worksheet to describe the baseline and alternative MSW management scenarios that you want to compare. The shaded areas indicate where you need to enter information.

1. **Describe the baseline generation and management for the MSW materials listed below. If the material is not generated in your community or you do not want to analyze it, leave it blank or enter 0. Make sure that the total quantity generated equals the total quantity managed.**

Material	Tons Generated	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted
Aluminum Cans					NA
Steel Cans					NA
Copper Wire					NA
Glass					NA
HDPE					NA
LDPE					NA
PET					NA
Corrugated Cardboard					NA
Magazines/Third-class Mail					NA
Newspaper					NA
Office Paper					NA
Phonebooks					NA
Textbooks					NA
Dimensional Lumber					NA
Medium-density Fiberboard					NA
Food Scraps		NA			
Yard Trimmings		NA			
Grass	22,500	NA	22,500		
Leaves	11,250	NA	11,250		
Branches	16,250	NA	16,250		
Mixed Paper (general)					NA
Mixed Paper (primarily residential)					NA
Mixed Paper (primarily from offices)					NA
Mixed Metals					NA
Mixed Plastics					NA
Mixed Recyclables					NA
Mixed Organics		NA			
Mixed MSW		NA			NA
Carpet					NA
Personal Computers					NA
Clay Bricks		NA		NA	NA
Aggregate				NA	NA
Fly Ash				NA	NA

Please enter data in short tons (1 short ton = 2,000 lbs.)

2. **Describe the alternative management scenario for the MSW materials generated in the baseline.**
   Any decrease in generation should be entered in the Source Reduction column.
   Any increase in generation should be entered in the Source Reduction column as a negative value.
   (Make sure that the total quantity generated equals the total quantity managed.)

Material	Baseline Generation	Tons Source Reduced	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted
Aluminum Cans	-					NA
Steel Cans	-					NA
Copper Wire	-					NA
Glass	-					NA
HDPE	-					NA
LDPE	-					NA
PET	-					NA
Corrugated Cardboard	-					NA
Magazines/Third-class Mail	-					NA
Newspaper	-					NA
Office Paper	-					NA
Phonebooks	-					NA
Textbooks	-					NA
Dimensional Lumber	-					NA
Medium-density Fiberboard	-					NA
Food Scraps	-	NA	NA			
Yard Trimmings	-	NA	NA			
Grass	22,500	NA	NA			22,500
Leaves	11,250	NA	NA			11,250
Branches	16,250	NA	NA			16,250
Mixed Paper, Broad	-	NA				NA
Mixed Paper, Resid.	-	NA				NA
Mixed Paper, Office	-	NA				NA
Mixed Metals	-	NA				NA
Mixed Plastics	-	NA				NA
Mixed Recyclables	-	NA				NA
Mixed Organics	-	NA	NA			
Mixed MSW	-	NA	NA			NA
Carpet	-					NA
Personal Computers	-					NA
Clay Bricks	-		NA		NA	NA
Aggregate	-	NA			NA	NA
Fly Ash	-	NA			NA	NA

Please enter data in short tons (1 short ton = 2,000 lbs.)

3. **To estimate the benefits from source reduction, EPA usually assumes that the material that is source reduced would have been manufactured from the current mix of virgin and recycled inputs. However, you may choose to estimate the emission reductions from source reduction under the assumption that the material would have been manufactured from 100% virgin inputs in order to obtain an upper bound estimate of the benefits from source reduction. Select which assumption you want to use in the analysis.**

- (•) Current Mix
- ( ) 100% Virgin

4a. The emissions from landfilling depends on whether the landfill where your waste is disposed has a landfill gas (LFG) control system. If you do not know whether your landfill has LFG control, select "National Average" to calculate emissions based on the estimated proportions of landfills with LFG control in 2000. If your landfill has a LFG system, select "LFG Recovery" and answer question 4b below. Otherwise, select "No LFG Recovery" and go to question 5.

- ( ) National Average
- (•) LFG Recovery
- ( ) No LFG Recovery

4b. If your landfill has gas recovery, does it recover the methane for energy or flare it?

- (•) Recover for energy
- ( ) Flare
- ( ) Not Applicable

4c. If your landfill has gas recovery, what is the efficiency of the system?
The national analysis assumes a gas collection system efficiency of 75%. If you do not know what the efficiency of your system is, you may want to use 75% as a default.

Landfill Gas Collection System Efficiency:		75%

5a. Emissions that occur during transport of materials to the management facility are included in this model. You may use default transport distances, indicated in the table below, or provide information on the transport distances for the various MSW management options.

- (•) Use Default Distances
- ( ) Provide Information

5b. If you have chosen to provide information, please fill in the table below.
Distances should be from the curb to the landfill, combustor, or material recovery facility (MRF).
*Please note that if you chose to provide information, you must provide distances for both the baseline and the alternative scenarios.

Management Option	Default Distance (Miles)	Distance (Miles)
Landfill	20	
Combustion	20	
Recycling	20	
Composting	20	

6. If you wish to personalize your results report, input your name & organization, and also specify the project period corresponding to the data you entered above.

Name	
Organization	

Project Period	From		to	

7. Please select between displaying units in metric tons of carbon equivalent (MTCE) and metric tons of carbon dioxide equivalent ($MTCO_2E$).

○ MTCE
◉ MTCO2E

8. If you are a participant in the U.S. Department of Energy's 1605(b) program, please check below. This will display the results phased over thirty years, by gas, and phased & by gas.

☐ DOE 1605(b) User

9. Check the button below to see results in units of energy consumption (million BTU) and equivalencies (e.g., cars off the road).

☐ Energy Consumption (million BTU)

Congratulations! You have finished all the inputs.
A summary of your results awaits you on the sheet(s) titled "Summary Report."
For more detailed analyses of GHG emissions, see the sheet(s) titled "Analysis Results."

WAste Reduction Model (WARM) -- Results

Total GHG Emissions from Baseline MSW Generation and Management ($MTCO_2E$):	(32,517)
Total GHG Emissions from Alternative MSW Generation and Management ($MTCO_2E$):	(9,905)
Incremental GHG Emissions ($MTCO_2E$):	22,612

$MTCO_2E$ = metric tons of carbon dioxide equivalent

Per Ton Estimates of GHG Emissions for Alternative Management Scenarios

Material	GHG Emissions per Ton of Material Source Reduced ($MTCO_2E$)	GHG Emissions per Ton of Material Recycled ($MTCO_2E$)	GHG Emissions per Ton of Material Landfilled ($MTCO_2E$)	GHG Emissions per Ton of Material Combusted ($MTCO_2E$)	GHG Emissions per Ton of Material Composted ($MTCO_2E$)
Aluminum Cans	(8.97)	(14.93)	0.04	0.06	NA
Steel Cans	(3.21)	(1.79)	0.04	(1.53)	NA
Copper Wire	(7.55)	(5.06)	0.04	0.06	NA
Glass	(0.58)	(0.28)	0.04	0.05	NA
HDPE	(1.81)	(1.41)	0.04	0.90	NA
LDPE	(2.29)	(1.71)	0.04	0.90	NA
PET	(2.12)	(1.55)	0.04	1.07	NA
Corrugated Cardboard	(2.83)	(2.74)	(0.49)	(0.66)	NA
Magazines/third-class mail	(4.30)	(2.70)	(0.66)	(0.48)	NA
Newspaper	(4.06)	(3.49)	(1.17)	(0.75)	NA
Office Paper	(3.64)	(2.46)	0.39	(0.83)	NA
Phonebooks	(5.23)	(3.34)	(1.17)	(0.75)	NA
Textbooks	(4.82)	(2.74)	0.39	(0.83)	NA
Dimensional Lumber	(2.02)	(2.45)	(0.95)	(0.79)	NA
Medium Density Fiberboard	(2.23)	(2.47)	(0.95)	(0.79)	NA
Food Scraps	NA	NA	0.15	(0.18)	(0.20)
Yard Trimmings	NA	NA	(0.79)	(0.22)	(0.20)
Grass	NA	NA	(0.21)	(0.22)	(0.20)
Leaves	NA	NA	(1.10)	(0.22)	(0.20)
Branches	NA	NA	(0.95)	(0.22)	(0.20)
Mixed Paper, Broad	NA	(3.17)	(0.49)	(0.66)	NA
Mixed Paper, Resid.	NA	(3.17)	(0.54)	(0.66)	NA
Mixed Paper, Office	NA	(3.06)	(0.36)	(0.60)	NA
Mixed Metals	NA	(7.27)	0.04	(0.47)	NA
Mixed Plastics	NA	(1.61)	0.04	0.97	NA
Mixed Recyclables	NA	(2.87)	(0.50)	(0.82)	NA
Mixed Organics	NA	NA	(0.37)	(0.20)	(0.20)
Mixed MSW	NA	NA	(0.08)	(0.13)	NA
Carpet	(4.10)	(7.38)	0.04	0.37	NA
Personal Computers	(58.07)	(2.46)	0.04	(0.20)	NA

Clay Bricks	(0.29)	NA	0.04	NA	NA
Aggregate	NA	(0.01)	0.04	NA	NA
Fly Ash	NA	(0.87)	0.04	NA	NA

GHG Emissions from Baseline Management of Municipal Solid Wastes

Material	Baseline Generation of Material (Tons)	Estimated Recycling (Tons)	Annual GHG Emissions from Recycling ($MTCO_2E$)	Estimated Landfilling (Tons)	Annual GHG Emissions from Landfilling ($MTCO_2E$)	Estimated Combustion (Tons)	Annual GHG Emissions from Combustion ($MTCO_2E$)	Estimated Composting (Tons)	Annual GHG Emissions from Composting ($MTCO_2E$)	Total Annual GHG Emissions ($MTCO_2E$)
Aluminum Cans	0	0	0	0	0	0	0	NA	NA	0
Steel Cans	0	0	0	0	0	0	0	NA	NA	0
Copper Wire	0	0	0	0	0	0	0	NA	NA	0
Glass	0	0	0	0	0	0	0	NA	NA	0
HDPE	0	0	0	0	0	0	0	NA	NA	0
LDPE	0	0	0	0	0	0	0	NA	NA	0
PET	0	0	0	0	0	0	0	NA	NA	0
Corrugated Cardboard	0	0	0	0	0	0	0	NA	NA	0
Magazines/third-class mail	0	0	0	0	0	0	0	NA	NA	0
Newspaper	0	0	0	0	0	0	0	NA	NA	0
Office Paper	0	0	0	0	0	0	0	NA	NA	0
Phonebooks	0	0	0	0	0	0	0	NA	NA	0
Textbooks	0	0	0	0	0	0	0	NA	NA	0
Dimensional Lumber	0	0	0	0	0	0	0	NA	NA	0
Medium Density Fiberboard	0	0	0	0	0	0	0	NA	NA	0
Food Scraps	0	NA	NA	0	0	0	0	0	0	0
Yard Trimmings	0	NA	NA	0	0	0	0	0	0	0
Grass	22,500	NA	NA	22,500	(4,675)	0	0	0	0	(4,675)
Leaves	11,250	NA	NA	11,250	(12,397)	0	0	0	0	(12,397)
Branches	16,250	NA	NA	16,250	(15,445)	0	0	0	0	(15,445)
Mixed Paper, Broad	0	0	0	0	0	0	0	NA	NA	0
Mixed Paper, Resid.	0	0	0	0	0	0	0	NA	NA	0
Mixed Paper, Office	0	0	0	0	0	0	0	NA	NA	0
Mixed Metals	0	0	0	0	0	0	0	NA	NA	0
Mixed Plastics	0	0	0	0	0	0	0	NA	NA	0
Mixed Recyclables	0	0	0	0	0	0	0	NA	NA	0
Mixed Organics	0	NA	NA	0	0	0	0	0	0	0
Mixed MSW	0	NA	NA	0	0	0	0	NA	NA	0
Carpet	0	0	0	0	0	0	0	NA	NA	0
Personal Computers	0	0	0	0	0	0	0	NA	NA	0
Clay Bricks	0	NA	NA	0	0	NA	NA	NA	NA	0
Aggregate	0	0	0	0	0	NA	NA	NA	NA	0
Fly Ash	0	0	0	0	0	NA	NA	NA	NA	0
Total	50,000	0	0	50,000	(32,517)	0	0	0	0	(32,517)

GHG Emissions from Projected Alternative Management of Municipal Solid Wastes

Material	Baseline Generation of Material (Tons)	Projected Source Reduction (Tons)	Annual GHG Emissions from Source Reduction ($MTCO_2E$)	Projected Recycling (Tons)	Annual GHG Emissions from Recycling ($MTCO_2E$)	Projected Landfilling (Tons)	Annual GHG Emissions from Landfilling ($MTCO_2E$)	Projected Combustion (Tons)	Annual GHG Emissions from Combustion ($MTCO_2E$)	Projected Composting (Tons)	Annual GHG Emissions from Composting ($MTCO_2E$)	Total Annual GHG Emissions ($MTCO_2E$)
Aluminum Cans	0	0	0	0	0	0	0	0	0	NA	NA	0
Steel Cans	0	0	0	0	0	0	0	0	0	NA	NA	0
Copper Wire	0	0	0	0	0	0	0	0	0	NA	NA	0
Glass	0	0	0	0	0	0	0	0	0	NA	NA	0
HDPE	0	0	0	0	0	0	0	0	0	NA	NA	0
LDPE	0	0	0	0	0	0	0	0	0	NA	NA	0
PET	0	0	0	0	0	0	0	0	0	NA	NA	0
Corrugated Cardboard	0	0	0	0	0	0	0	0	0	NA	NA	0
Magazines/third-class mail	0	0	0	0	0	0	0	0	0	NA	NA	0
Newspaper	0	0	0	0	0	0	0	0	0	NA	NA	0
Office Paper	0	0	0	0	0	0	0	0	0	NA	NA	0
Phonebooks	0	0	0	0	0	0	0	0	0	NA	NA	0
Textbooks	0	0	0	0	0	0	0	0	0	NA	NA	0
Dimensional Lumber	0	0	0	0	0	0	0	0	0	NA	NA	0
Medium Density Fiberboard	0	0	0	0	0	0	0	0	0	NA	NA	0
Food Scraps	0	NA	NA	NA	NA	0	0	0	0	0	0	0
Yard Trimmings	0	NA	NA	NA	NA	0	0	0	0	0	0	0
Grass	22,500	NA	NA	NA	NA	0	0	0	0	22,500	(4,457)	(4,457)
Leaves	11,250	NA	NA	NA	NA	0	0	0	0	11,250	(2,229)	(2,229)
Branches	16,250	NA	NA	NA	NA	0	0	0	0	16,250	(3,219)	(3,219)
Mixed Paper, Broad	0	NA	NA	0	0	0	0	0	0	NA	NA	0
Mixed Paper, Resid.	0	NA	NA	0	0	0	0	0	0	NA	NA	0
Mixed Paper, Office	0	NA	NA	0	0	0	0	0	0	NA	NA	0
Mixed Metals	0	NA	NA	0	0	0	0	0	0	NA	NA	0
Mixed Plastics	0	NA	NA	0	0	0	0	0	0	NA	NA	0
Mixed Recyclables	0	NA	NA	0	0	0	0	0	0	NA	NA	0
Mixed Organics	0	NA	NA	NA	NA	0	0	0	0	0	0	0
Mixed MSW	0	NA	NA	NA	NA	0	0	0	0	NA	NA	0
Carpet	0	0	0	0	0	0	0	0	0	NA	NA	0
Personal Computers	0	0	0	0	0	0	0	0	0	NA	NA	0
Clay Bricks	0	0	0	NA	NA	0	0	NA	NA	NA	NA	0
Aggregate	0	NA	NA	0	0	0	0	NA	NA	NA	NA	0
Fly Ash	0	NA	NA	0	0	0	0	NA	NA	NA	NA	0
Total	50,000	0	0	0	0	0	0	0	0	50,000	(9,905)	(9,905)

Incremental GHG Emissions from Projected Alternative Management of Municipal Solid Wastes

Analysis Results (MTCO2E)

Material	Source Reduction (Tons)	Incremental GHG Emissions from Source Reduction ($MTCO_2E$)	Incremental Recycling (Tons)	Incremental GHG Emissions from Recycling ($MTCO_2E$)	Incremental Landfilling (Tons)	Incremental GHG Emissions from Landfilling ($MTCO_2E$)	Incremental Combustion (Tons)	Incremental GHG Emissions from Combustion ($MTCO_2E$)	Incremental Composting (Tons)	Incremental GHG Emissions from Composting ($MTCO_2E$)	Total Incremental GHG Emissions ($MTCO_2E$)
Aluminum Cans	0	0	0	0	0	0	0	0	NA	NA	0
Steel Cans	0	0	0	0	0	0	0	0	NA	NA	0
Copper Wire	0	0	0	0	0	0	0	0	NA	NA	0
Glass	0	0	0	0	0	0	0	0	NA	NA	0
HDPE	0	0	0	0	0	0	0	0	NA	NA	0
LDPE	0	0	0	0	0	0	0	0	NA	NA	0
PET	0	0	0	0	0	0	0	0	NA	NA	0
Corrugated Cardboard	0	0	0	0	0	0	0	0	NA	NA	0
Magazines/third-class mail	0	0	0	0	0	0	0	0	NA	NA	0
Newspaper	0	0	0	0	0	0	0	0	NA	NA	0
Office Paper	0	0	0	0	0	0	0	0	NA	NA	0
Phonebooks	0	0	0	0	0	0	0	0	NA	NA	0
Textbooks	0	0	0	0	0	0	0	0	NA	NA	0
Dimensional Lumber	0	0	0	0	0	0	0	0	NA	NA	0
Medium Density Fiberboard	0	0	0	0	0	0	0	0	NA	NA	0
Food Scraps	NA	NA	NA	NA	0	0	0	0	0	0	0
Yard Trimmings	NA	NA	NA	NA	0	0	0	0	0	0	0
Grass	NA	NA	NA	NA	(22,500)	4,575	0	0	22,500	(4,457)	218
Leaves	NA	NA	NA	NA	(11,250)	12,397	0	0	11,250	(2,229)	10,168
Branches	NA	NA	NA	NA	(16,250)	15,445	0	0	16,250	(3,219)	12,226
Mixed Paper, Broad	NA	NA	0	0	0	0	0	0	NA	NA	0
Mixed Paper, Resid.	NA	NA	0	0	0	0	0	0	NA	NA	0
Mixed Paper, Office	NA	NA	0	0	0	0	0	0	NA	NA	0
Mixed Metals	NA	NA	0	0	0	0	0	0	NA	NA	0
Mixed Plastics	NA	NA	0	0	0	0	0	0	NA	NA	0
Mixed Recyclables	NA	NA	0	0	0	0	0	0	NA	NA	0
Mixed Organics	NA	NA	NA	NA	0	0	0	0	0	0	0
Mixed MSW	NA	NA	NA	NA	0	0	0	0	NA	NA	0
Carpet	0	0	0	0	0	0	0	0	NA	NA	0
Personal Computers	0	0	0	0	0	0	0	0	NA	NA	0
Clay Bricks	0	0	NA	NA	0	0	NA	NA	NA	NA	0
Aggregate	NA	NA	0	0	0	0	NA	NA	NA	NA	0
Fly Ash	NA	NA	0	0	0	0	NA	NA	NA	NA	0
Total	0	0	0	0	(50,000)	32,517	0	0	50,000	(9,905)	22,612

a) For explanation of methodology, see the EPA report:
Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks (EPA530-R-02-006)
-- available on the Internet at http://www.epa.gov/mswclimate/greengas.pdf (1.1 Mb PDF file).

b) Emissions estimates provided by this model are intended to support voluntary GHG measurement and reporting initiatives.

EXHIBIT 4

Delaware Natural Resources & Environmental Control

Division of Air and Waste Management

Newsroom

December 6, 2006

Volume 36, Number 434

DNREC
NEWS
The Delaware Department of Natural Resources and Environmental Control

December 6, 2006
Volume 36, Number 434
Division of Air and Waste Management

Contact: Deb Nielsen, Division of Air and Waste Management, phone: (302) 739-9403
or Melanie Rapp, Public Affairs, phone: (302) 739-9902

Yard Waste Management Info: Answers for Homeowners; New Castle County Yard Waste Ban Goes Into Effect Jan. 1

Beginning January 1, New Castle County homeowners are required to separate all yard waste materials from their regular trash. Yard wastes include all plant materials resulting from lawn maintenance and landscaping activities and would include grass, leaves, prunings, brush, shrubs, garden materials, Christmas trees, and tree limbs up to 4 inches in diameter.

The ban on yard waste at the Cherry Island Landfill will take effect on January 1, 2007, however it won't be fully enforced by DNREC until the spring or summer. This period of transition gives homeowners, landscapers and haulers time to prepare. In the interim, DNREC will work with the Delaware Solid Waste Authority to educate New Castle County residents and businesses on the ban.

The ban on yard wastes from the Cherry Island landfill near Wilmington was implemented to divert an additional 45,000 tons of material per year from Cherry Island. Generally if you live in northern New Castle County and your wastes go to the Cherry Island landfill, you are affected by the ban. To find out for sure, call whoever handles your trash, whether it's your city or a private trash hauler.

Homeowners have three options to dispose of yard wastes:

• Keep the material on your property and manage it by composting, mulching and grasscycling (leaving the grass on your lawn).

Workshops, classes and demonstrations on composting are given throughout the year. For more information and scheduling, please contact: Hetty E. Francke, Master Gardener at the University of Delaware's Cooperative Extension Office, hettyw@udel.edu or 302-475-9157.

• Drop-off yard waste at a composting/mulching facility.

DSWA Composting/Mulching (operation for yard waste)
Located at the Cherry Island Landfill (at the intersection of 12th St. and Hay Rd.)
Wilmington
1-800-404-7080

Strobert Tree Services Inc.
1506 A Street
Wilmington
302-475-7089 or visit www.cuttree.net

• Arrange to have the material picked up by a company that provides this service, including a hauler or a landscaping company.

Contact your regular trash hauler to see if they have a plan for handling yard waste. If they do not, visit DNREC's web site for a list of companies that offer the service, www.dnrec.delaware.gov/yardwaste/YardWasteHomeowners/htm

Yard waste makes up nearly a quarter of the residential waste in Delaware. Cherry Island Landfill is reaching its ultimate capacity. The landfill has been issued a "terminal permit" for just one more expansion, after which a new site must be found in a county running out of land. This process could take 10 years. Here, in tiny Delaware, waste diversion makes even more sense than in our larger neighboring states, all three of which have restrictions on yard waste disposal.

For more information, contact Deb Nielsen, Division of Air and Waste Management, 302-739-9403 or visit DNREC's web site, www.dnrec.delaware.gov Click on "Yard Waste Info."

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Return to Story List

DELAWARE ANNUAL AIR QUALITY REPORT

2006

Air Quality Management Section
Division of Air and Waste Management
Department of Natural Resources and Environmental Control

715 Grantham Lane
New Castle, DE 19720
(302) 323-4542

and

156 South State Street
Dover, DE 19901
(302) 739-9402

Doc. No. 40-09-02/07/10/01

A word from Ali Mirzakhalili, Delaware's Air Quality Administrator

"Blue Skies Delaware; Clean Air for Life", this is Air Quality Management's vision for Delaware. Air Quality Management developed this new vision statement to guide us in our role as guardians of a precious natural resource, the air we breathe.

This report provides you with an outline of the Air Quality Management Section's organizational structure and responsibilities; it provides you with the latest air quality data summary and makes available contact information in case you want additional information. This report also presents a summary of what we are doing to clean up Delaware's air quality and keep it clean.

We look forward to a day when Delawareans have good air quality every day of the year, when our visibility is not blocked by haze and when we are no longer concerned with excessive amounts of toxics in our air. To reach this important goal we need your help. This report provides you with information on what you can do to help our clean air efforts, it is vital that you get involved.

On the cover – aerial photograph of Delaware's Inland Bays. Photo by Joanna Wilson, cover design by John Thomas and Christy Shaffer.

EXECUTIVE SUMMARY

Delaware's 2006 annual air quality report continues to document the changes and overall improvement in ambient air quality in the state. In 2006 only two pollutants, ozone and $PM_{2.5}$, exceed or are close to the national ambient air quality standards. Other pollutants monitored in Delaware (SO_2, CO, NO_2, and PM_{10}) are well below the national standards.

As measured by the air quality index (AQI), there are fewer days that fall into the category of moderate or unhealthy for sensitive populations. There were more days with good air in 2006 than in past years.

For ozone, there were six exceedances of the 8-hour ozone standard in 2006; however, there were no exceedances of the 1-hour standard. Ozone concentrations continue to show a generally decreasing trend in all three counties in recent years.

New Castle County was declared non-attainment for $PM_{2.5}$ based on concentrations that were above the annual average air quality standard during 2001 - 2003; the most recent three years (2004 – 2006) show concentrations that continue to be close to the level of the air quality standard. Kent and Sussex counties continue to record concentrations below the standard.

Concentrations of air toxics in Wilmington continue to show generally low or declining levels.

Emissions of air pollutants are calculated every three years as part of a comprehensive emissions inventory. The most recent inventory was for 2002 and the next update will cover 2005.

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DELAWARE ANNUAL AIR QUALITY REPORT
2006

INTRODUCTION

In 1970, Congress passed the Clean Air Act that authorized the Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS) for pollutants shown to threaten human health and welfare. Primary standards were set according to criteria designed to protect public health, including an adequate margin of safety to protect sensitive populations such as children and asthmatics. Secondary standards were set according to criteria designed to protect public welfare (decreased visibility, damage to crops, vegetation, and buildings, etc.).

Seven pollutants currently have NAAQS: ozone (O_3), carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns ($PM_{2.5}$) and lead (Pb). These are commonly called the "criteria" pollutants. When air quality does not meet the NAAQS, the area is said to be in “nonattainment” with the NAAQS.

This report covers Delaware’s air quality status and trends for the criteria pollutants and some non-criteria pollutants. Non-criteria pollutants are substances that do not have standard criteria for ambient concentrations. These include acid precipitation and air toxics.

This document also contains material specifying the sources of air pollution and actual inventory data detailing information related to the compounds responsible for ozone and $PM_{2.5}$ formation. Accompanying these data is information concerning in-use emission control measures as well as suggestions on what we can do to prevent air pollution. Technical details regarding monitoring activities and emission inventories, along with references and sources of more information, are included in the appendices.

GENERAL INFORMATION

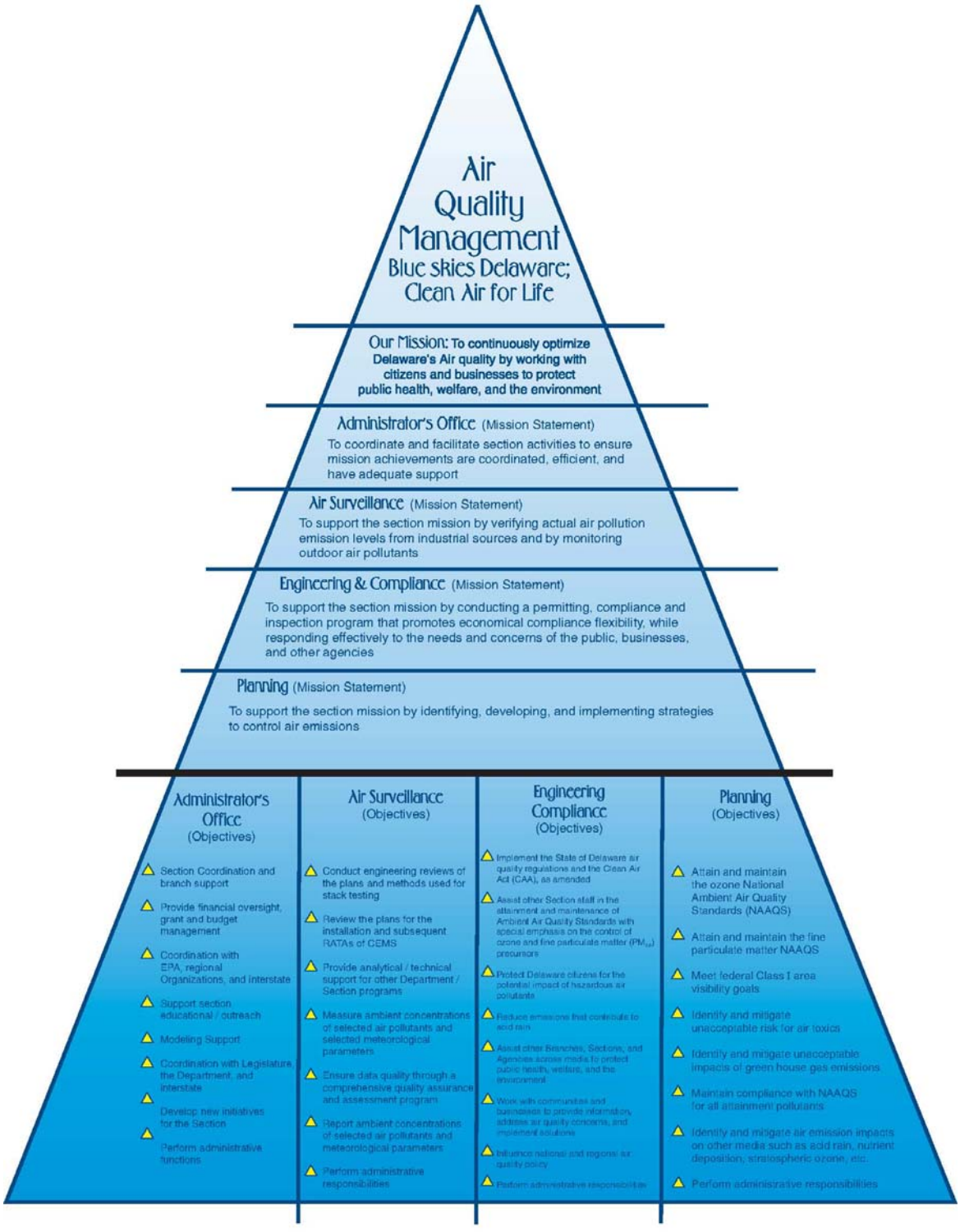
ABOUT DELAWARE'S AIR QUALITY MANAGEMENT SECTION

Air Quality Management (AQM) Section is operated through an Air Quality Administrator and is organized by branches that are defined as:

- Air Surveillance
- Engineering and Compliance
- Planning

Each Branch in the AQM has created a mission statement. A mission statement defines in one or two sentences any entity's reason for existence. It embodies its philosophies, goals, ambitions and more. Consistent with these mission statements, branch-specific objectives have been developed. These objectives are brief, clear statements of outcomes that are related to and flow from the vision / mission. The vision/mission/branch-specific objectives are identified in the following pyramid.

Each branch has uniquely defined objectives that collectively support the AQM vision.


Air Quality Management
Blue skies Delaware; Clean Air for Life
Our Mission: To continuously optimize Delaware's Air quality by working with citizens and businesses to protect public health, welfare, and the environment
Administrator's Office (Mission Statement)
To coordinate and facilitate section activities to ensure mission achievements are coordinated, efficient, and have adequate support
Air Surveillance (Mission Statement)
To support the section mission by verifying actual air pollution emission levels from industrial sources and by monitoring outdoor air pollutants
Engineering & Compliance (Mission Statement)
To support the section mission by conducting a permitting, compliance and inspection program that promotes economical compliance flexibility, while responding effectively to the needs and concerns of the public, businesses, and other agencies
Planning (Mission Statement)
To support the section mission by identifying, developing, and implementing strategies to control air emissions
Administrator's Office (Objectives)
Section Coordination and branch support
Provide financial oversight, grant and budget management
Coordination with EPA, regional Organizations, and interstate
Support section educational / outreach
Modeling Support
Coordination with Legislature, the Department, and interstate
Develop new initiatives for the Section
Perform administrative functions
Air Surveillance (Objectives)
Conduct engineering reviews of the plans and methods used for stack testing
Review the plans for the installation and subsequent RATAs of CEMS
Provide analytical / technical support for other Department / Section programs
Measure ambient concentrations of selected air pollutants and selected meteorological parameters
Ensure data quality through a comprehensive quality assurance and assessment program
Report ambient concentrations of selected air pollutants and meteorological parameters
Perform administrative responsibilities
Engineering Compliance (Objectives)
Implement the State of Delaware air quality regulations and the Clean Air Act (CAA), as amended
Assist other Section staff in the attainment and maintenance of Ambient Air Quality Standards with special emphasis on the control of ozone and fine particulate matter ($PM_{2.5}$) precursors
Protect Delaware citizens for the potential impact of hazardous air pollutants
Reduce emissions that contribute to acid rain
Assist other Branches, Sections, and Agencies across media to protect public health, welfare, and the environment
Work with communities and businesses to provide information, address air quality concerns, and implement solutions
Influence national and regional air quality policy
Perform administrative responsibilities
Planning (Objectives)
Attain and maintain the ozone National Ambient Air Quality Standards (NAAQS)
Attain and maintain the fine particulate matter NAAQS
Meet federal Class I area visibility goals
Identify and mitigate unacceptable risk for air toxics
Identify and mitigate unacceptable impacts of green house gas emissions
Maintain compliance with NAAQS for all attainment pollutants
Identify and mitigate air emission impacts on other media such as acid rain, nutrient deposition, stratospheric ozone, etc.
Perform administrative responsibilities

Engineering and Compliance Branch

The Engineering and Compliance Branch inspects and issues air pollution control permits for minor and major stationary air pollution sources. Branch personnel make periodic facility inspections and review emission test results to ensure that permit conditions are being met. Compliance or enforcement actions are initiated for violation of regulations or permit conditions when warranted.

Air Surveillance Branch

Source Monitoring Program

The Source Monitoring Program verifies actual air pollution emission levels from industrial sources. Actual emission levels are needed to establish air pollution control permit conditions and to verify compliance with permit conditions after a permit has been issued. The program is also responsible for verifying the accuracy of source emission testing. This is done to evaluate the operation of facility owned Continuous Emission Monitoring Systems (CEMS).

Ambient Air Quality Monitoring Program

The Ambient Air Quality Monitoring Program monitors pollutants in ambient air. This is primarily accomplished by conducting long-term, fixed-site air monitoring of specific air pollutants. Most monitoring is focused on the pollutants that have standards set by the U.S. EPA to protect public health and are commonly called “criteria” pollutants. This program also conducts or assists in special short-term air monitoring studies as resources allow. Data are used to provide the public with information on current air quality conditions, assess compliance with or progress made towards meeting NAAQS, measure long term air quality trends for urban and non-urban areas, verify the effectiveness of air pollution control strategies, support State Implementation Plan development, evaluate air emission inventories, and verify computer models.

Planning Branch

Emission Inventory Development Program

The Emission Inventory Development Program works to develop comprehensive emission inventories of regulated pollutants from all emission source sectors, including point sources, stationary non-point sources, mobile sources and natural sources, as well as to compile periodic inventory data, procedures and documentation into comprehensive reports that are available to the public.

Airshed Evaluation and Planning Program

As mandated by the Federal Clean Air Act, all states must achieve and maintain attainment of the NAAQS. Delaware and the surrounding states are in “non-attainment” of some of those standards. The air quality problem that requires immediate attention is ground-level ozone. Other pollutants to be addressed include fine particulate matter, regional haze and hazardous air pollutants as defined by the Environmental Protection Agency. The Airshed Evaluation and

Planning Program seeks to find ways to reverse the non-attainment of an air quality standard--the combination of air pollution problems that are either generated locally or result from emissions transported through the atmosphere from distant areas. The vehicle used to accomplish this result is the preparation and adoption of planning documents entitled State Implementation Plans. These are usually in the form of revisions to existing plans.

Area Sources Compliance Program

The Areas Source Compliance group inspects and issues air pollution control permits for smaller sources, such as dry cleaners, auto body shops, gasoline tank trucks, open burning activity and asbestos abatement projects. Group personnel make periodic facility inspections and review data to ensure that permit and regulatory requirements are being met. Compliance or enforcement actions are initiated for violation of regulations or permit conditions when warranted.

FREQUENTLY ASKED QUESTIONS

1. What is a “criteria” air pollutant?

   A “criteria” air pollutant is an air pollutant that has had a National Ambient Air Quality Standard (NAAQS) established for it by the U.S. EPA. There are currently seven criteria pollutants: sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, particulate matter less than 10 microns in diameter (PM_{10}), and particulate matter less than 2.5 microns in diameter ($PM_{2.5}$).

2. What is the difference between a primary and secondary National Ambient Air Quality Standard?

   Primary standards are set to protect human health. Secondary standards are set to protect public welfare and take into consideration such factors as crop damage, architectural damage, damage to ecosystems, and visibility in scenic areas.

3. How is the location of an air monitoring station decided?

   Multiple factors are considered when deciding the location of air monitoring stations. Sites are selected based on the purpose of the monitoring (representative ambient concentrations, maximum source impact, etc.), the pollutant or pollutants to be monitored, the population density, location of other monitoring stations (including those in other states) and operational efficiency. The U.S. EPA has developed siting requirements for each of the “criteria” air pollutants. These requirements include distance from trees, buildings and roadways, distance from major point sources, and height of the sampler probe or inlet. Other factors include site security and access, availability of electricity and telephone service, aesthetics and local zoning issues, and long-term (+10 years) site availability. Unfortunately, the ideal monitoring site is virtually impossible to acquire, especially in urban areas.

   Air monitoring stations are primarily used to house continuous instruments that measure “criteria” air pollutants (those that have established National Ambient Air Quality Standards). Monitoring for particulate matter is often accomplished by setting up instrumentation on a sampling platform.

   Delaware has had air monitoring sites located around the state since the late 1960’s. The original focus of the monitoring network was on monitoring close to “point” sources (large facilities with high emissions). As air pollution control strategies were successfully implemented and the emissions from large facilities were brought into compliance with air quality regulations, the focus has shifted to pollutants that are more of a regional problem.

4. How large an area does an air monitoring station represent?

   Depending on the location of a station and the pollutant being monitored, the data from a given site can represent a large geographical area or a smaller local area impacted by specific sources.

5. What air quality factors should be considered when buying a house?

   The air quality problem that affects the most Delawareans is the build up of ground-level ozone on certain hot summer days. Ozone is a regional air quality problem that does not vary dramatically over distances of several miles, and all three counties in Delaware can have days exceeding the air quality standard.

   New Castle County also does not meet the air quality standard for fine particulate matter.

   Become an informed consumer. Drive and walk around the area. Do you see any potential air pollution sources? Where are the major roadways? Does anyone in your family have any known allergies or personal health problems that could make them more sensitive to a specific pollutant? Ask the current residents and neighbors if they have observed any problems. Be aware that you can sometimes be bothered more by a small air pollution source that is close than by a large source that is farther away.

6. What do I do if I have a complaint about an odor or other air quality issues?

   Odors and other environmental complaints can be reported to the Environmental Emergency and Complaints 24-hour Hotline at **1-800-662-8802**.

7. How can I get current air quality data?

   Near real time air quality data and other information is available on the Air Quality Management Section web page.
   http://www.dnrec.state.de.us/air/aqm_page/airmont/air.asp

8. How can I get historical air quality data?

   Historic air quality data for Delaware and other states is available on the internet at: www.epa.gov/air/data/

9. Why can't I burn my trash?

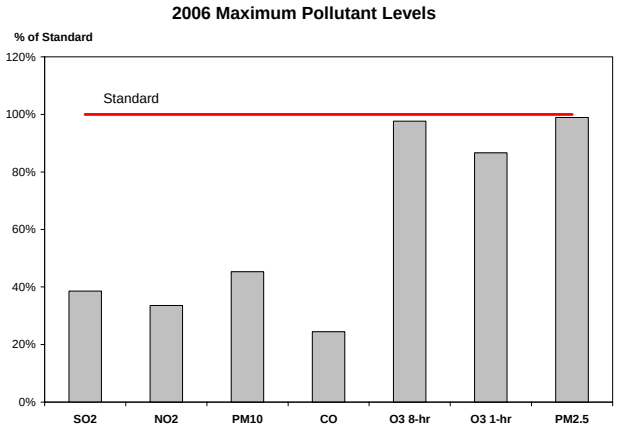
   The open burning of trash, where smoke and other emissions are released directly into the air without passing through a chimney, is illegal throughout all of Delaware at all times of the year. Open trash burning emits large amounts of toxic air pollutants some of which may be cancer causing. The amount of air pollution from 35 average burn barrels has been estimated as the equivalent of 1 regulated hazardous waste incinerator. The burning of trash also emits pollutants that contribute to other air quality problems such as ground-level ozone formation, odor complaints, fine particles, and visibility.

10. Who can I call about an indoor air quality problem?

    Indoor air quality problems are handled by the Environmental Health Evaluation Branch of the Division of Public Health. **(302) 744-4540.**

DELAWARE'S AIR QUALITY STATUS

Delaware is currently in attainment with all the National Ambient Air Quality Standards except ozone and $PM_{2.5}$. Over the last ten years, trends in ambient concentrations of the criteria pollutants have been either level or declining.



AIR QUALITY INDEX (AQI)

Description

The Air Quality Index or AQI was created by the U.S. EPA as a measure of overall air quality. The AQI was developed to ensure national uniformity of daily air quality reports, and the procedures and calculations used to generate the AQI are defined by EPA.

Ambient concentrations of five pollutants ($PM_{10}/PM_{2.5}$, SO_2, CO, O_3, and NO_2) are used to calculate a health-related value or index. The data represents the previous 24 hours. For each pollutant, a subindex is calculated using a mathematical function that transforms ambient pollutant concentrations onto a scale from zero to 500, with 100 corresponding to the National Ambient Air Quality Standard (NAAQS). Index ranges and descriptions are listed below. In 2000, the U.S. EPA added a new category "Unhealthy for Sensitive Groups".

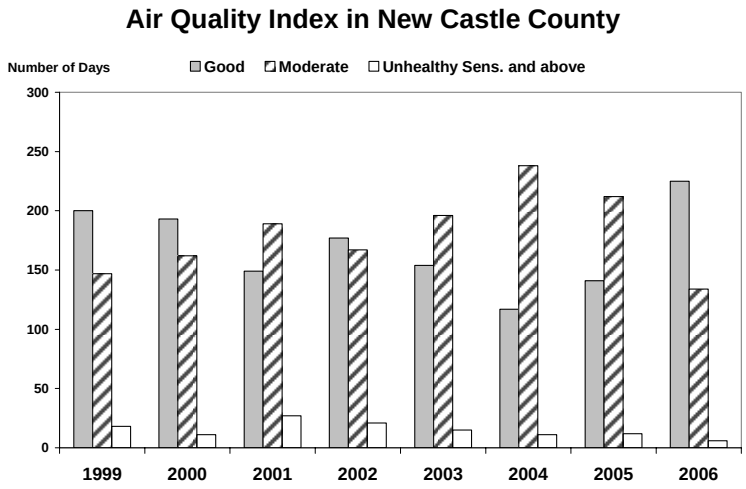
0 to 50	"Good"
51 to 100	"Moderate"
101 to 150	"Unhealthy for Sensitive Groups"
151 to 200	"Unhealthy"
200 to 299	"Very Unhealthy"
300 and above	"Hazardous"

Air Quality Index (AQI)

Delaware calculates and reports an AQI for the Wilmington area every working day and reports it to the American Lung Association for distribution to the local media. According to EPA guidelines, only monitors that represent air quality in the Wilmington urban area are used to generate this index. In June 2000, the U.S. EPA changed the AQI to include $PM_{2.5}$ for the first

time. This resulted in more days falling into the Moderate or Unhealthy for Sensitive People categories.

The accompanying graph reflects the AQI trends calculated for New Castle County from 1999 through 2006. Data for the entire county, not just the city of Wilmington, is used in this graph. The number of days with unhealthy air quality has been generally declining in recent years, and the number of days with good air quality has been increasing.



Delaware Air Monitoring Network

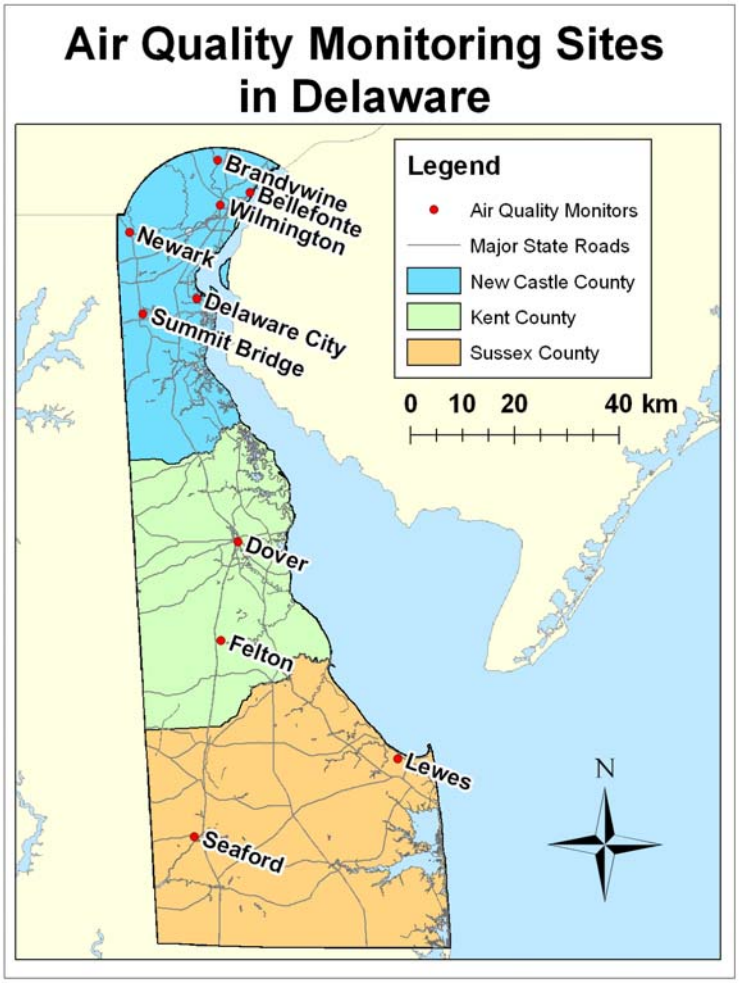
The State of Delaware has established an air monitoring network to determine the ambient levels of the pollutants for which NAAQS have been established. The Delaware Air Monitoring Network consists of the sites and monitors listed in the following table and figure. Although monitoring takes place statewide, most of the stations are concentrated in the northern urban/industrial areas, which have the highest population and number of pollutant sources. This network is maintained and operated by the Air Surveillance Branch of the Air Quality Management Section, Division of Air and Waste Management, DNREC.

The gaseous criteria pollutants, along with wind speed and wind direction, are measured continuously with hourly averages computed and reported via a telemetry system to the central data storage computer in the AQM New Castle office. Particulates are collected as 24-hour samples that run every sixth day, and acid rain is monitored weekly.

Delaware Air Monitoring Network 2006

"X" indicates pollutant monitored

SITE	SO_2	NO_2	CO	O_3	PM_{10}	$PM_{2.5}$	Wind Speed/ Direction	Acid Rain
Brandywine				X				
Bellefonte	X			X		X		
Wilm. - MLK Blvd	X	X	X		X	X	X	
Ommelanden								X
Newark						X		
Delaware City	X		X				X	
Summit Bridge	X			X		X		
Dover						X		
Felton				X		X	X	
Seaford				X		X	X	
Lewes				X			X	



More information on Delaware's ambient air monitoring network can be found on the Air Quality Management Section's webpage as the Delaware Ambient Air Monitoring Network Description (http://www.awm.delaware.gov/Info/PubComAmbientAir.htm).

AIR QUALITY - POLLUTANTS THAT EXCEED STANDARDS: OZONE AND $PM_{2.5}$

OZONE (O_3)

Description

Ozone (O_3) is a highly reactive gas that is the main component of smog. Ozone in the lower atmosphere (troposphere) is considered a pollutant and is distinct from the ozone layer in the upper atmosphere (stratosphere) where it acts as a shield from ultraviolet radiation. Ozone is a strong respiratory irritant that affects healthy individuals as well as those with impaired respiratory systems. It can cause respiratory inflammation and reduce lung function.

Ozone also adversely affects trees, crops (soybeans are a particularly sensitive species), and other vegetation. The national agricultural loss from ozone pollution is estimated by the U.S. EPA to be several billion dollars annually. It is also implicated in white pine damage and reduced growth rates for red spruce; studies have shown forest and ecosystem damage can result from high ozone concentrations.

Standards

Primary NAAQS:

Maximum eight-hour average = 0.08 ppm

The eight-hour standard is achieved when the annual fourth highest daily eight-hour concentration, averaged over three years, is less than or equal to 0.08 ppm.

Maximum one-hour = 0.12 ppm, former NAAQS, current Delaware AAQS. *Note: EPA revoked the one hour standard for ozone in June 2005 but Delaware has maintained the1-hour standard in its regulations (Regulation 3).*

The one-hour standard is achieved when the expected number of days, averaged over three years, with a maximum hourly average of greater than 0.12 ppm (235 Fg/m^3) is less than or equal to one.

Sources

Ozone is not emitted directly from a pollution source but is formed in the lower atmosphere by the reaction of nitrogen oxides (NO_X) and volatile organic compounds (VOCs) in the presence of sunlight and warm temperatures. Sources of nitrogen oxides include automobiles, power plants and other combustion activities. VOCs can come from automobiles, gasoline vapors, and a variety of large and small commercial and industrial sources that use chemical solvents, paint thinners, and other chemical compounds. These compounds or “precursors of ozone” can travel for miles before chemical reactions in the atmosphere form ozone.

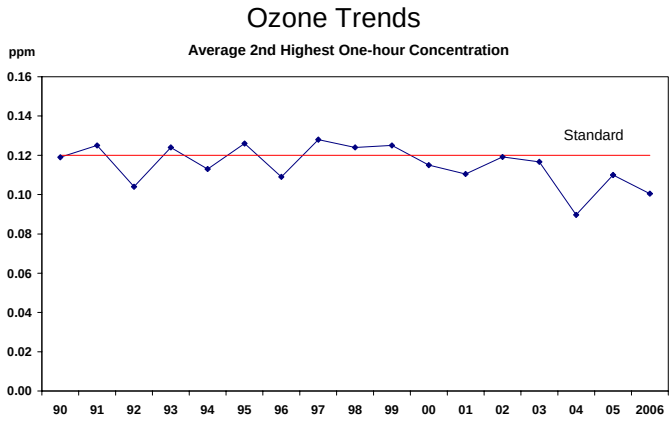
Controlling ozone is a complex task due to the wide variety of sources for nitrogen oxides and VOCs as well as the long-distance transport of ozone and its precursors. Control methods include regulation to control gasoline vapor emissions, inspection and maintenance programs for motor vehicle exhausts, and regulation of VOC and NO_X emissions from industrial sources.

Locations

Ozone is monitored throughout the state. Monitors are located away from or at some distance downwind of urban areas and major traffic corridors in order to avoid "scavenging" of ozone by NO emissions. See the "Delaware Air Monitoring Network" table on page 9 for specific sites. While short-term 1-hour average peak ozone levels are highest in New Castle County, longer-term 8-hour averages are above the standard throughout Delaware.

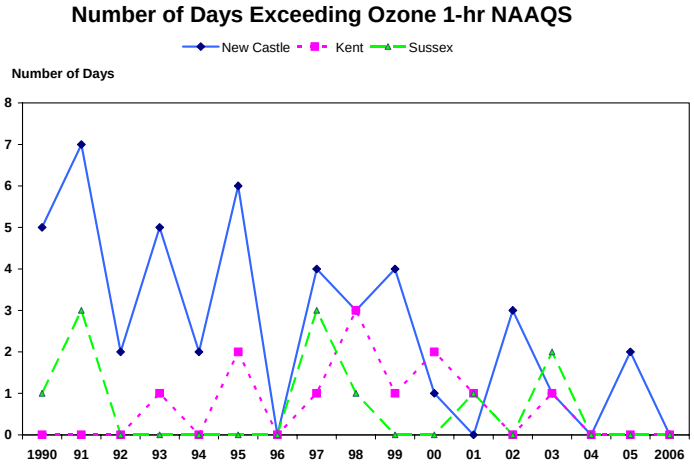
Delaware Air Quality and Trends

Trends in ozone concentrations are often difficult to discern due to the effect of meteorology. Hot, dry weather and stagnant air favor the formation of ozone, and the greatest number of exceedance days typically occur during the hottest and driest summers. Ozone levels in the 1990's were better than in the 1980's and are continuing to show generally decreasing levels.



One-hour Ozone Data and Trends

2006 was a relatively hot summer, which tends to favor high ozone concentrations; however, there were no days on which the one-hour NAAQS was exceeded in Delaware. This shows continuing improvement in air quality.



Delaware Exceedances of the One-Hour Ozone NAAQS

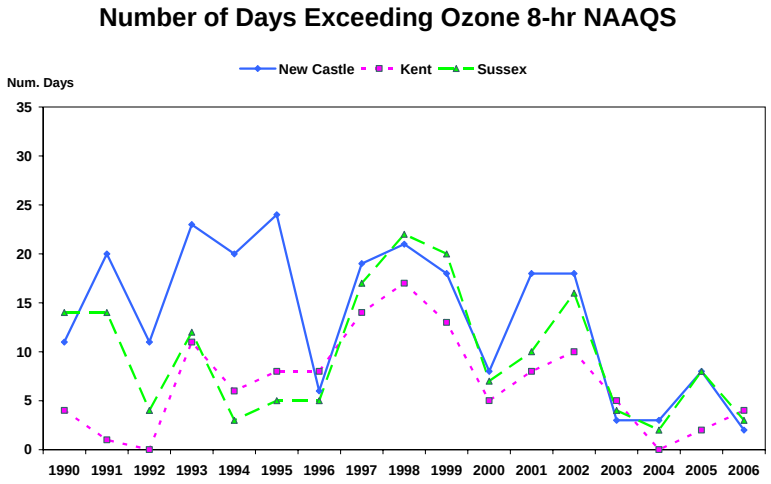
Total number of days at each site with a daily one-hour maximum $ 0.12 ppm

Year	Site								County			State
	Smt	Blfte	Clmt	Brnd	Dver	Fltn	Sfrd	Lws	NC	K	S	
1984	3	2	2		1		0		4	1	0	5
1985	5	4	2		2		1		8	2	1	10
1986	0	6	0		0		0		6	0	0	6
1987	3	6	6		3		1		9	3	1	12
1988	15	15	15		10		8		23	10	8	28
1989	2	1	2		0		0		4	0	0	4
1990	4	4	2		0		1		5	0	1	6
1991	6	3	2		*0		3		7	0	3	9
1992	1	1	0		0		0		2	0	0	2
1993	5	2	0		1		0		5	1	0	5
1994	2	0		[a]0	0		0		2	0	0	2
1995	5	5		3		2	0		6	2	0	6
1996	0	0		0		0	0		0	0	0	0
1997	4	1		2		1	3	1	4	1	3	7
1998	2	1		1		3	1	0	3	3	1	6
1999	2	2		4		1	0	0	4	1	0	4
2000	1	1		1		2	0	0	1	2	0	3
2001	0	0		0		1	1	0	0	1	1	2
2002	1	2		3		0	0	0	3	0	0	2
2003	0	0		1		1	2	0	1	1	2	2
2004	0	0		0		0	0	0	0	0	0	0
2005	2	0		0		0	0	0	2	0	0	2
2006	0	0		0		0	0	0	0	0	0	0

* No data May 22 - July 22, 1991 [a] Site became operational 8/1/94 ND = no data

Eight-hour Ozone Data and Trends

There were six days in Delaware that exceeded the 8-hour standard. There were two days in New Castle County, four days in Kent County, and three days in Sussex County. As with the 1-hour exceedances, weather plays a major role and makes it difficult to determine pollutant trends; however, 2003 and 2004 represent two consecutive years with relatively few days exceeding the 8-hour standard in New Castle County. Although there was a slight increase in the number of days with exceedances in 2005, 2006 continues to show an overall improving trend in air quality.



2006 Eight-hour Averages Exceedances and Maximum (ppm)

Site	Num. Exc.	1st Max.	2nd Max.	3rd Max.	4th Max.
Brandywine	2	0.093	0.090	0.081	0.081
Bellefonte	1	0.088	0.084	0.082	0.082
Summit Bridge	2	0.095	0.089	0.084	0.081
Felton	4	0.089	0.088	0.086	0.085
Seaford	1	0.089	0.083	0.083	0.082
Lewes	3	0.088	0.087	0.085	0.080

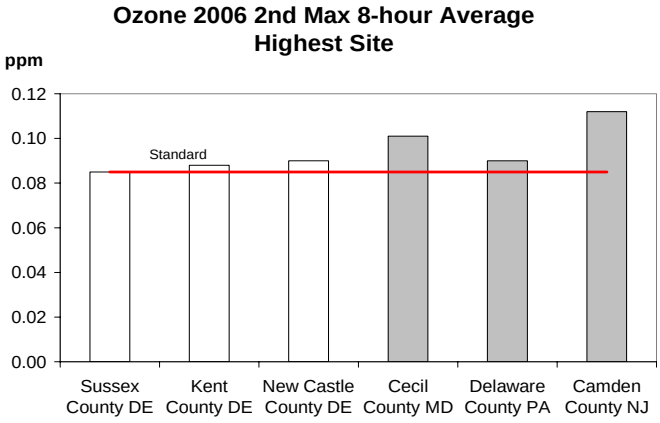
Num. Exceedances = Number of days with at least one 8-hour average $ 0.085 ppm.

3-Year Average of 4th Daily Max. Eight-hour Avg.

NAAQS = 0.08 ppm

Site	1998-2000	1999-2001	2000-2002	2001-2003	2002-2004	2003-2005	2004-2006
Brandywine	0.096	0.096	0.096	0.093	0.089	0.082	0.082
Bellefonte	0.090	0.092	0.092	0.090	0.086	0.082	0.081
Summit Bridge	0.097	0.097	0.097	0.093	0.084	0.080	0.078
Felton	0.097	0.094	0.093	0.089	0.084	0.080	0.080
Seaford	0.098	0.095	0.094	0.091	0.086	0.082	0.080
Lewes	0.095	0.091	0.088	0.088	0.085	0.084	0.082

How does Delaware's air quality compare to nearby areas?
Ozone levels in Delaware are similar to those in nearby areas.

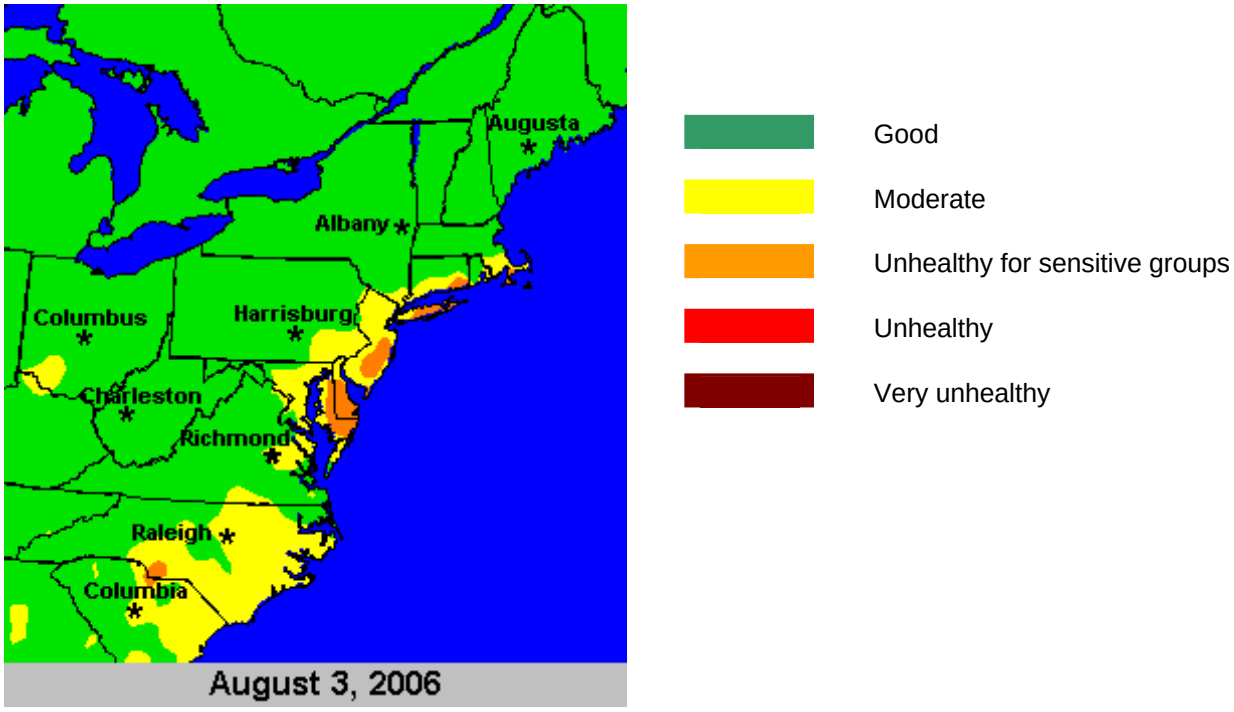


Ozone Mapping Project
As part of the Ozone Mapping Project, participating states and local agencies submit real-time ground-level ozone data to a centralized computer. The data is converted into color-coded maps of ground-level ozone concentrations. These maps are then distributed to local television stations for inclusion in the weather segment of the news program. Stations are most likely to broadcast the map during periods of poor air quality.

The purpose of the ozone mapping project is to increase awareness of elevated ozone concentrations so people can take protective measures and to educate the public about the regional nature of ozone formation and transport. For more information and examples of maps, please visit the EPA "AirNow" web site at http://www.epa.gov/airnow.

Following is an example of an ozone map showing the regional nature of ozone episodes.

Air Quality Index Peak Values - August 3, 2006



Source: EPA Ozone Mapping Project, AIRNOW website http://www.epa.gov/airnow/

PARTICULATE MATTER - FINE ($PM_{2.5}$)

Description

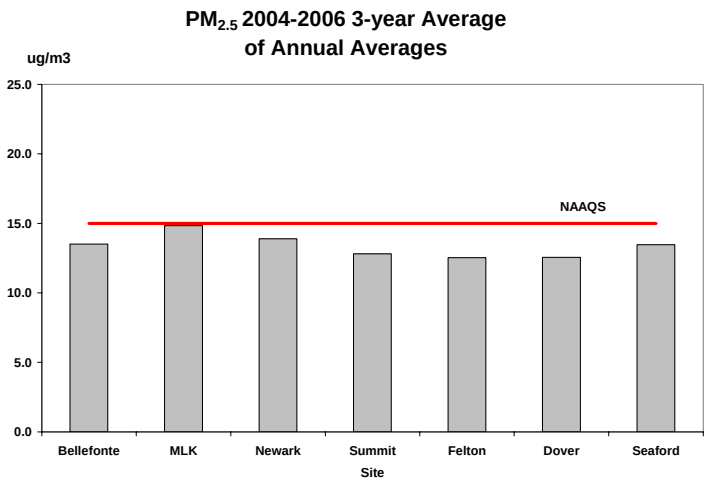
Fine particulate matter is made up of particles smaller than 2.5 microns in diameter. These fine particles, also called $PM_{2.5}$, penetrate more deeply into the lungs than coarse particles (2.5 - 10 microns) and are more likely to contribute to health effects. Health effects of concern associated with particulate matter pollution demonstrated in recent community studies include premature death and increased hospital admissions and emergency room visits, primarily by the elderly and individuals with cardiopulmonary disease, increased respiratory symptoms and disease in children and individuals with cardiopulmonary disease, and decreased lung function and alterations in lung tissue and structure, particularly in children and people with asthma.

Standards

Primary NAAQS: Annual arithmetic mean = 15 Fg/m^3 averaged over three years
24-Hour maximum = 65 Fg/m^3 as the 98th percentile averaged over three years (A new 24-hour maximum standard of 35 Fg/m^3 became effective on December 16, 2006. This new standard will be addressed in 2007 Air Quality Report.

Sources

Fine particles ($PM_{2.5}$) are generally emitted from combustion activities (such as industrial and residential fuel burning and motor vehicles) while coarse particles come from dust emitted during activities such as construction and agricultural tilling. $PM_{2.5}$ can also form in the atmosphere from precursor compounds, such as SO_2 and NO_X, through various physical and chemical processes.



Locations

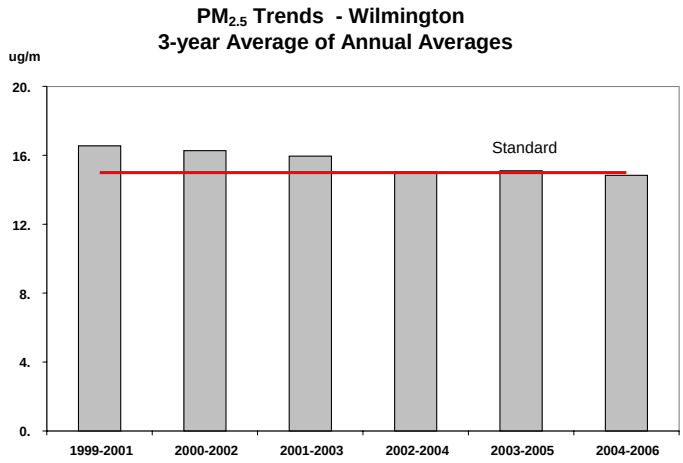
Monitors are located throughout Delaware, with the majority of monitors in New Castle County where the highest concentrations occur. See the table on page 9 for specific sites.

Delaware Air Quality and Trends

Delaware's monitoring network began collecting data in January 1999. Three years of complete data are required for comparison to the national standard.

New Castle County has been designated non-attainment for $PM_{2.5}$ based on the 16.0 Fg/m^3 three-

year average of the annual averages for 2001 to 2003 at the urban Wilmington site. For the most recent three-year period (2004 - 2006), the highest average in New Castle County was 14.8 ug/m^3, which is very close to the $PM_{2.5}$ annual standard, while Kent and Sussex counties were below the standard. The 98th percentile 24-hour average $PM_{2.5}$ standard is met in all three counties; however, this is expected to change with the implementation of the new $PM_{2.5}$ 98th percentile standard of 35 Fg/m^3 in 2007. There will be more information on this in the 2007 Annual Air Quality Report.



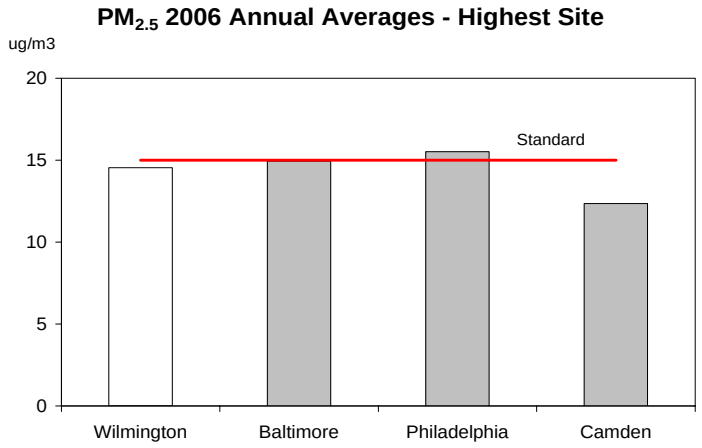
The highest concentrations continue to be at the urban Wilmington MLK site; however, there is significant correlation between all sites. For example, if high concentrations of $PM_{2.5}$ are recorded at one site, all other sites also record high concentrations on that day. Both local and regional sources of fine particulate matter and its precursors (a substance that is the source of another substance) contribute to concentrations seen in Delaware. Overall, there is a decreasing trend in the annual average concentrations at all sites.

Delaware 2004 - 2006 $PM_{2.5}$ Data Summary

Site	3-year Average of Annual Averages NAAQS = 15Fg/m^3	3-year Average of 98th Percentiles NAAQS = 65Fg/m^3
Felton	12.6	32
Dover	12.5	31
Bellefonte	13.5	33
Summit Bridge	12.8	32
Wilmington MLK	14.8	36
Newark	13.9	32
Seaford	13.5	34

How does Delaware's air quality compare to nearby areas?

Air quality in Delaware is similar to nearby areas.



AIR QUALITY - POLLUTANTS THAT MEET STANDARDS: CO, NO_2, PM_{10}, SO_2, Lead

CARBON MONOXIDE (CO)

Description

Carbon monoxide is a colorless, odorless, poisonous gas produced by incomplete combustion of fossil fuels. It reduces the blood's ability to carry oxygen. Exposure can cause fatigue, headache, and impaired judgment and reflexes at moderate concentrations; at high levels unconsciousness and death can result. People with heart disease, angina, emphysema and other lung or cardiovascular diseases are most susceptible.

Standards

Primary NAAQS: 8-hour average = 9 ppm (10 Fg/m^3)
1-hour average = 35 ppm (40 Fg/m^3)
Not to be exceeded more than once per year

Sources

Carbon monoxide is formed when carbon in fuels is not completely burned. The U.S.EPA estimates that approximately 60% of all CO emissions are from motor vehicle exhaust. Other sources include incinerators, wood stoves, furnaces, and some industrial processes. Concentrations are highest along heavily traveled highways, and decrease significantly with increasing distance from traffic. Therefore, CO monitors are usually located close to roadways or in urban areas.

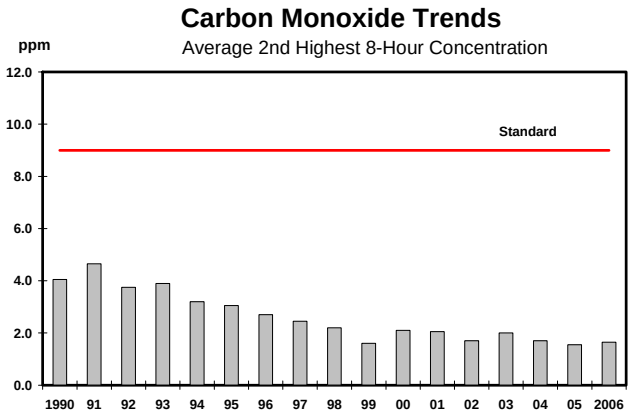
Locations

Monitors for CO are located in Wilmington and along Route 9 north of Delaware City.

Delaware Air Quality and Trends

Mobile sources cause most of the ambient CO detected at the Wilmington MLK site.

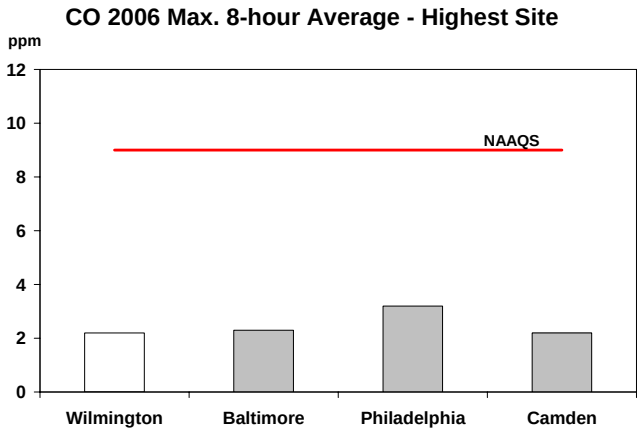
There has been a slight downward trend in CO concentrations since monitoring began in the 1970's, and no violations of the ambient standards have occurred since 1977. Improvements are largely due to cleaner burning engines in cars and tighter automobile emission standards. Low concentrations continued in 2006.



Delaware Carbon Monoxide (CO) 2006 Max. Values
ppm

Site	1-Hour Avg. NAAQS = 35 ppm		8-Hour Avg. NAAQS = 9 ppm	
	1st Max.	2nd Max.	1st Max.	2nd Max.
Wilmington	3.0	2.9	2.2	2.2
Delaware City	1.5	1.4	1.2	1.1

How does Delaware's air quality compare to nearby areas?
Most CO monitors are located in urban areas. CO concentrations monitored in Wilmington are similar to those in nearby areas.



NITROGEN DIOXIDE (NO_2)

Description

Nitrogen dioxide (NO_2) is a reddish-brown toxic gas that is part of a group of gases containing nitrogen and oxygen called oxides of nitrogen or NO_X. Nitrogen dioxide irritates the lungs and upper respiratory system and lowers resistance to respiratory infections. It can be fatal in high concentrations. Nitrogen dioxide is also known to damage vegetation by stunting growth and reducing seed production. It acts to reduce visibility. Reactions between nitrogen dioxide and other compounds in the atmosphere can form nitric acid, which contributes to the acid rain problem. Oxides of nitrogen can also have a significant impact on fine particulate matter concentrations, most notably in the western areas of the United States.

One of the most important features of NO_X is their ability to react with volatile organic compounds (VOCs) to form ozone. Air quality computer models have shown that control of NO_X is necessary in many areas of the United States to reach attainment of the ozone standard.

Atmospheric deposition of oxides of nitrogen has recently been estimated to be a significant source of nitrogen to bodies of water such as the Chesapeake Bay and Delaware's Inland Bays. Nitrogen acts as a nutrient and contributes to excess nutrient loading and algal blooms in estuary systems.

Standards

Primary NAAQS: Annual arithmetic mean = 0.053 ppm (100 Fg/m^3)

Sources

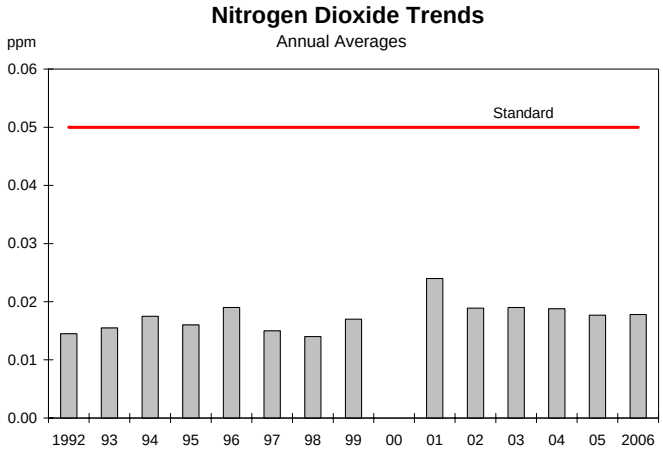
Oxides of nitrogen are produced during high-temperature burning of fuels. Sources of NO_X include motor vehicles and stationary sources that burn fossil fuels such as power plants and industrial boilers.

Locations

Since 2001, Delaware has monitored NO_2 only in Wilmington. There was insufficient data to generate an average for 2000.

Delaware Air Quality and Trends

Nitrogen dioxide levels in Delaware have remained well below the NAAQS since monitoring began. In 2006, levels continued to remain well below the standard.

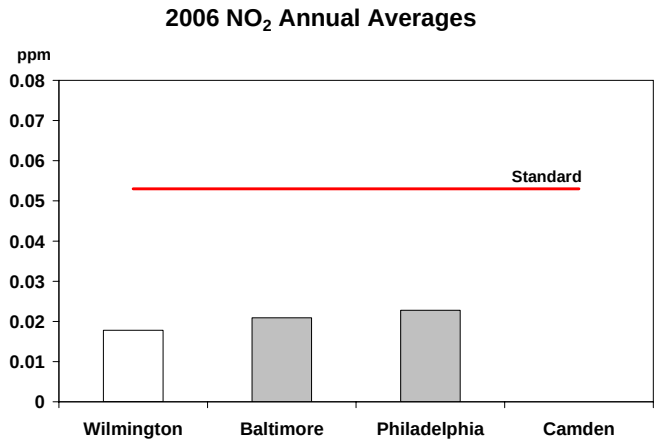


Delaware Nitrogen Dioxide (NO_2)
Annual Arithmetic Means in ppm

Site	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Wilmington					*	.024	.019	.019	.019	.018	.018
Bellefonte	.019	.018	.016	.017	*						
Summit	*	.012	.012								

* Insufficient data to calculate annual average.

How does Delaware's air quality compare to nearby areas?
Most NO_2 monitors are located in urban areas. NO_2 concentrations monitored in Delaware are similar to those in nearby areas.



PARTICULATE MATTER (PM_{10})

Description

PM_{10} is the fraction of total suspended particulate matter (TSP) that is less than 10 microns in diameter, which is about 1/7 the diameter of a human hair. Particles of this size are small enough to be inhaled into the lungs. Particulate matter can include solid or liquid droplets that remain suspended in the air for various lengths of time.

Particulates small enough to be inhaled can carry other pollutants and toxic chemicals into the lungs while larger particulates can cause coughing and throat irritation. Major effects of PM_{10} listed by EPA include aggravation of existing respiratory and cardiovascular disease, alterations in immune responses in the lung, damage to lung tissue, carcinogenesis and premature mortality. The most sensitive populations are those with chronic obstructive pulmonary or cardiovascular disease, asthmatics, the elderly, and children. Particulates are also a major cause of reduced visibility and can be involved in corrosion of metals (acidic dry deposition).

Standards

Primary NAAQS: Annual arithmetic mean = 50 Fg/m^3
24-Hour maximum = 150 Fg/m^3 not to be exceeded more than once per year averaged over three years.

Sources

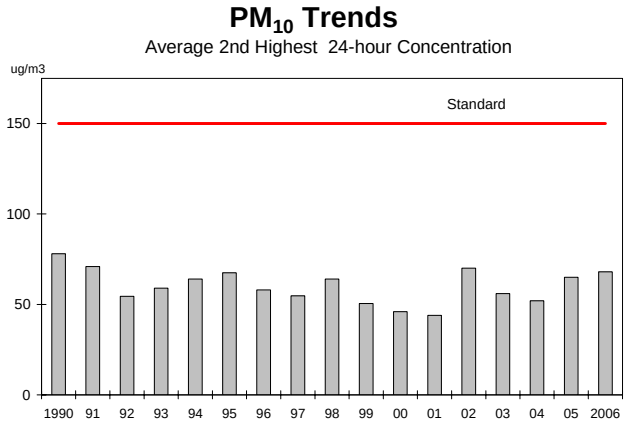
Major sources include steel mills, power plants, motor vehicles, industrial plants, unpaved roads, and agricultural tilling. The wide variety of PM_{10} sources means that the chemical and physical composition of the particles are highly variable.

Locations

Because resources were shifted to support $PM_{2.5}$ monitoring, and PM_{10} concentrations have been consistently below the standard, PM_{10} is currently monitored only at the urban Wilmington site.

Delaware Air Quality and Trends

Delaware is in attainment with the PM_{10} NAAQS. The increases in concentrations in 2005 and 2006 are related to nearby construction and road improvement projects in the Riverfront area.



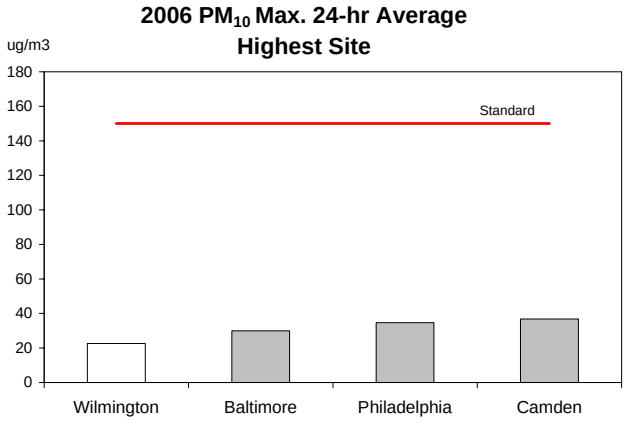
Delaware PM_{10} Trends

Annual Average $\mu g/m^3$

Site	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Bellefonte	25.9	25.3	29.0	24.4	24.9						
Wilmington	32.1	31.9	28.4	27.8	26.4	23.0	23.0	20.3	19.8	22.5	22.6
Seaford	24.0	24.4									

How does Delaware's air quality compare to nearby areas?

PM_{10} concentrations in Delaware are similar to nearby areas.



SULFUR DIOXIDE (SO_2)

Description

Sulfur dioxide (SO_2) is a pungent, poisonous gas. It is an irritant that can interfere with normal breathing functions even at low levels. It aggravates respiratory diseases such as asthma, emphysema, and bronchitis. These effects can be magnified by high particulate levels. High SO_2 levels can obstruct breathing passages and cause increased death rates among people with existing heart and lung disease.

Sulfur dioxide can bind to dust particles and aerosols in the atmosphere, traveling long distances on the prevailing winds. It can also be oxidized to SO_3 and combine with water vapor to form sulfuric acid and fall as acid rain, causing materials damage and harming aquatic life. Sulfur compounds contribute to visibility degradation in many areas including national parks. Sulfur dioxide in the atmosphere can also cause plant chlorosis and stunted growth.

Standards

Primary NAAQS: Annual arithmetic mean = 0.03 ppm (80 Fg/m^3)
24-hour average = 0.14 ppm (365 Fg/m^3)
Secondary NAAQS: 3-hour average = 0.5 ppm (1300 Fg/m^3)

Sources

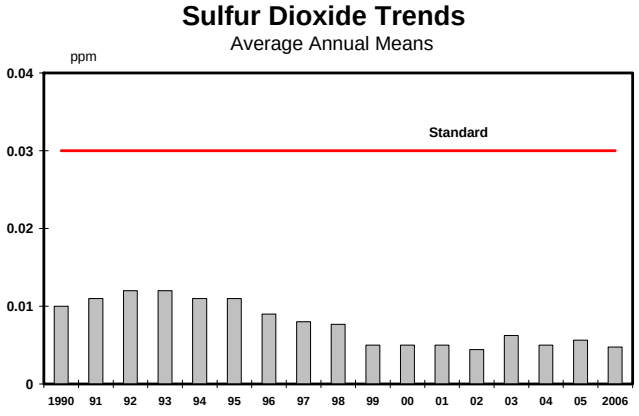
The main sources of SO_2 are combustion of coal and oil (mostly by power plants), refineries, smelters, and industrial boilers. Nationally, two-thirds of all sulfur dioxide emissions are from power plants, and coal-fired plants account for 95% of these emissions.

Locations

Delaware's SO_2 monitors are located in Wilmington, Bellefonte, Summit Bridge, and Delaware City.

Delaware Air Quality and Trends

Delaware is in attainment with the NAAQS for SO_2. Levels declined rapidly in the 1970's due largely to the change to low or lower sulfur fuels in power plants and improved control technologies. Over the last decade, measured ambient levels have remained well below the standard with a slight downward trend. Locally, higher levels are found only in areas impacted by a single large source (such as a coal-burning power plant or oil refinery).



In 2006, SO_2 levels remained well below the standards.

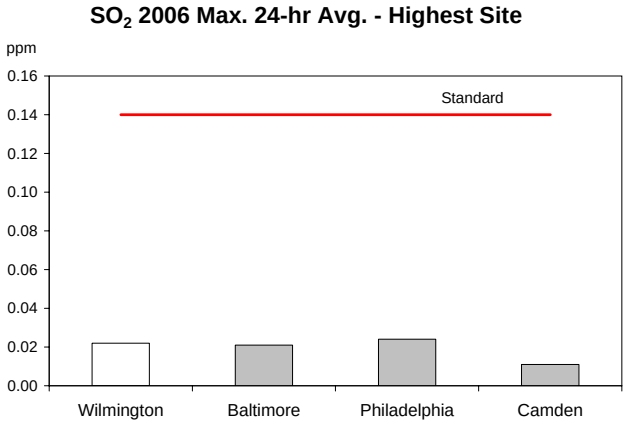
Delaware Sulfur Dioxide 2006
Max. Values ppm

Site	24-Hour Averages NAAQS = 0.14 ppm		3-Hour Averages NAAQS = 0.5 ppm	
	1st Max	2nd Max	1st Max	2nd Max
Bellefonte	0.022	0.019	0.101	0.053
Wilm. - MLK	0.016	0.016	0.039	0.035
Del. City/Rte 9	0.063	0.054	0.158	0.119
Summit Bridge	0.015	0.012	0.040	0.034

Delaware Sulfur Dioxide Trends
Annual Averages in ppm
NAAQS: Annual Arithmetic Mean = 0.03 ppm

Site	Year											
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Bellefonte	.008	.008	.007	.007	.005	.007	.005	.004	.007	.005	.007	.005
Wilmington	.012	.011	.008	.008								
Wilm.-MLK					.004	.005	.006	.005	.006	.005	.005	.005
Summit Br.							.003	.003	.004	.004	.004	.003
Del City	.013	.011	.011	.008	.007	.006	.006	.006	.008	.006	.007	.007
Seaford	.008	.008	.006									

How does Delaware's air quality compare to nearby areas?
SO_2 concentrations in Delaware are similar to those in nearby areas.



LEAD (Pb) - no monitors currently active in Delaware

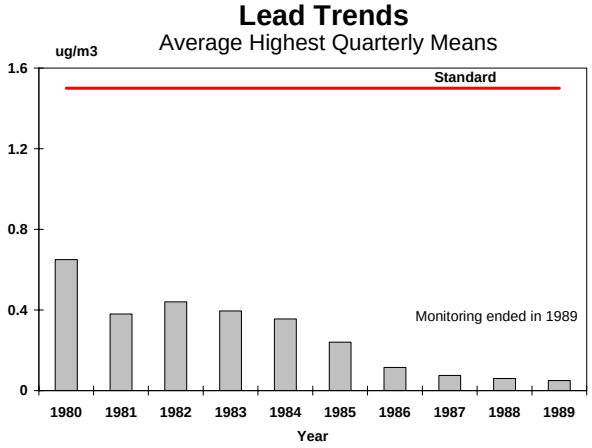
Description and Sources
Lead is a highly toxic metal emitted into the air from both mobile and stationary sources. Mobile sources include vehicles that use leaded fuel. Major stationary sources include metal smelters and lead battery plants.

Exposure can occur through a number of pathways including ingestion and inhalation. Lead affects several physiological processes including the blood-forming, reproductive, nervous and renal (kidney) systems. It accumulates in both bone and soft tissues and can cause problems long after exposure is ended. Infants and children are most susceptible to effects that can include anemia, seizures, mental retardation, and decreased learning abilities.

Standard
Primary NAAQS: 24-hour average (averaged over one calendar quarter) = 1.5 Fg/m^3

Locations
Monitors were formerly located in Claymont and Wilmington.

Delaware Air Quality and Trends
Delaware is in attainment with the NAAQS for lead and does not currently monitor lead in ambient air as a criteria pollutant. Previously, there were two lead monitoring sites placed for measuring lead coming mostly from mobile sources. Measured ambient concentrations decreased by approximately 94% between 1978 and 1988 due to the change to unleaded gasoline in cars. In 1989, the last year in which samples were collected, 63% of the samples were below the analytical detection limits.



Special note: Lead is included in the metals analysis performed on $PM_{2.5}$ "speciation" samples and total suspended particulate air toxics samples. This data will be addressed in the 2007 Annual Air Quality Report.

AIR QUALITY - POLLUTANTS WITHOUT STANDARDS: Acid Precipitation and Air Toxics

ACID PRECIPITATION

Description

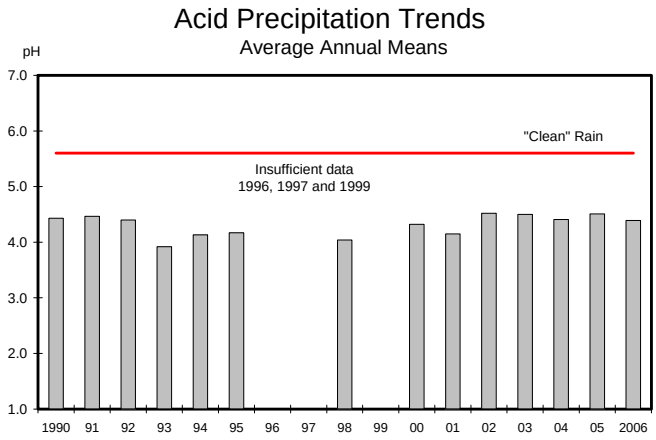
Acid precipitation, more commonly called acid rain, is rain, snow, or fog that contains significant amounts of sulfuric and/or nitric acids. Various combustion processes release sulfur and nitrogen oxides into the air where they react to form acids and can travel for many miles. Acid rain is measured using a scale called "pH." The lower a substance's pH, the more acidic it is. Pure water has a pH of 7.0. According to the U.S. EPA, normal rain is slightly acidic because carbon dioxide dissolves into it, so it has a pH of about 5.5. In 2000, the most acidic rain falling in the US had a pH of about 4.3.

Sources

The largest sources of sulfur oxides are coal burning power plants, which are mainly located along the Ohio River valley. These plants are also significant sources of nitrogen oxides, as are motor vehicles. Prevailing winds carry these pollutants to the east and north, resulting in the most acidic precipitation occurring in the northeastern United States and Canada.

Locations

Acid precipitation was monitored at two sites, Georgetown and Summit Bridge, from 1984 to 1993. The Georgetown site was terminated in 1993. In 2000, the Summit Bridge monitor was relocated to the Ommelanden range on Route 9.



Delaware Air Quality and Trends

There was insufficient data to calculate an annual average for 1996, 1997 and 1999 due to a combination of resource and quality control issues. The relocation of the monitor in early 2000 and improved analytical equipment resolved the problems. In 2006, precipitation remained acidic, with an average annual pH of 4.51.

AIR TOXICS

Description
Toxic air pollutants, also called air toxics or hazardous air pollutants, are pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental effects. In 1990, Delaware began developing a routine ambient air sampling program for selected volatile organic compounds (VOCs). In 2000, this program was updated by changing the sampling and analytical method to detect a greater number of VOCs. In 2003, the program was expanded to include other types of chemical compounds such as carbonyls and heavy metals.

Sources
Sources of ambient air toxics include both stationary and mobile types. Stationary industrial sources can include power plants, chemical manufacturing plants, and refineries. There are many smaller stationary sources (sometimes referred to as "area" sources) such as dry cleaners, printers, and automobile paint shops. Mobile sources include both on- and off-road motor vehicles as well as boats and aircraft.

Locations
From 1990 to 1999, VOC samples were collected at four monitoring sites including Wilmington, Delaware City, Summit Bridge, and Seaford. With the change in monitoring method in 2000, samples were collected only at the Wilmington MLK site. From 2003 through 2004, VOCs, carbonyls, and heavy metals were collected at five sites throughout the state. Due to resource restrictions, in 2006 monitoring ended at three of those sites in September, and only MLK and Delaware City had a full year of data.

Delaware Air Quality and Trends
Ambient VOC levels are consistently below 10 ppb for all monitored compounds, and most are below 1 ppb. Only VOCs are included in this year’s report; carbonyls and metals will be added in the 2007 report.

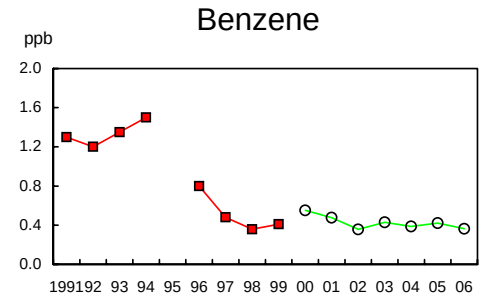
Control programs that focus on improving ambient ozone levels by reducing emissions of VOCs, as well as programs specifically aimed at controlling emissions of hazardous air pollutants, are continuing to reduce ambient concentrations of many air toxics. Although the change in monitoring method makes interpretation difficult, ambient concentrations of most VOCs are generally declining at the Wilmington site.

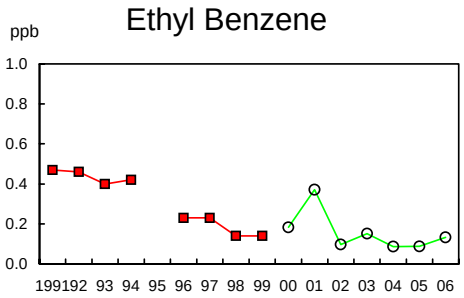
2006 Air Toxics Data in ppb - Wilmington

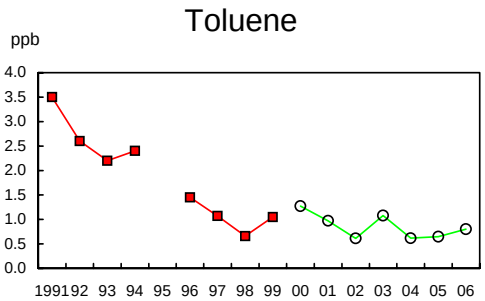
Compound Name	Average	Minimum	Maximum
Dichlorodifluoromethane	0.51	0.45	0.65
Chloromethane	0.62	0.48	0.86
1,2-Dichloro-1,1,2,2,Tetrafluorolethane	0.02	0.01	0.02
Chloroethene	0.01	0.00	0.05
1,3-Butadiene	0.08	0.00	0.30
Bromomethane	0.03	0.00	0.37
Chloroethane	0.01	0.00	0.07
Trichlorofluoromethane	0.28	0.23	0.33
Acetone	4.92	1.42	21.58
1,1-Dichloroethene	0.00	0.00	0.02
Methylene Chloride	0.17	0.05	2.13
Carbon Disulfide	0.03	0.00	0.26
1,1,2-Trichloro-1,2,2-Trifluoroethane	0.08	0.07	0.10
Trans-1,2-Dichloroethene	0.00	0.00	0.00
1,1-Dichloroethane	0.00	0.00	0.01
2-Methoxy-2-Methyl-Propane	0.53	0.00	5.07
Methyl Ethyl Ketone (2-Butanone)	0.48	0.16	1.20
Cis-1,2-Dichloroethene	0.00	0.00	0.01
Hexane	0.30	0.05	1.42
Chloroform	0.02	0.01	0.06
Ethyl Acetate	0.07	0.00	0.53
Tetrahydrofuran	0.06	0.00	0.67
1,2-Dichloroethane	0.01	0.00	0.02
1,1,1-Trichloroethane	0.02	0.01	0.03
Benzene	0.36	0.13	1.13
Carbon Tetrachloride	0.08	0.06	0.10
Cyclohexane	0.07	0.00	0.34
1,2-Dichloropropane	0.00	0.00	0.01
Bromodichloromethane	0.00	0.00	0.03
Trichloroethene	0.01	0.00	0.03
Heptane	0.12	0.02	0.52
Cis-1,3-Dichloro-1-Propene	0.00	0.00	0.00
Methyl Isobutyl Ketone	0.03	0.00	0.20
Trans-1,3-Dichloro-1-Propene	0.00	0.00	0.00
1,1,2-Trichloroethane	0.00	0.00	0.01
Toluene	0.80	0.15	3.12
Dibrochloromethane	0.00	0.00	0.00
Methyl Butyl Ketone (2-Hexanone)	0.04	0.00	0.16
1,2-Dibromoethane	0.00	0.00	0.00
Tetrachloroethylene	0.07	0.01	0.28

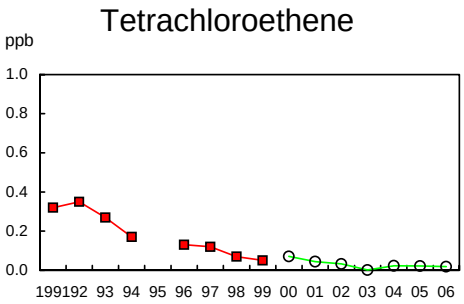
Compound Name	Average	Minimum	Maximum
Chlorobenzene	0.01	0.00	0.01
Ethylbenzene	0.13	0.03	0.61
m & p- Xylene	0.38	0.07	1.70
Bromoform (Tribromomethane)	0.00	0.00	0.01
Styrene	0.03	0.01	0.15
1,1,2,2-Tetrachloroethane	0.00	0.00	0.01
o-Xylene	0.13	0.03	0.52
1-Ethyl-4-Methylbenzene	0.05	0.01	0.19
1,3,5-Trimethylbenzene	0.04	0.01	0.19
1,2,4-Trimethylbenzene	0.14	0.03	0.56
Benzyl Chloride	0.00	0.00	0.05
1,3-dichlorobenzene	0.00	0.00	0.01
1,4-Dichlorobenzene	0.03	0.00	0.10
1,2-Dichlorobenzene	0.00	0.00	0.03
1,2,4-Trichlorobenzene	0.00	0.00	0.01
Hexachloro-1,3-Butadiene	0.00	0.00	0.01

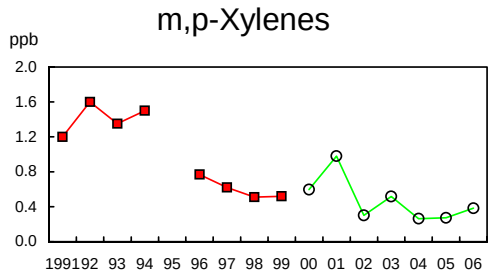
Wilmington Air Toxics Trends - Annual Averages Selected Compounds
Notes: Insufficient data in 1995 to calculate annual average. New Method used in 2000.

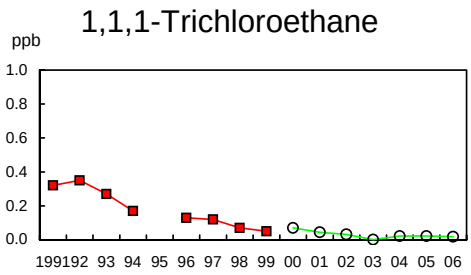


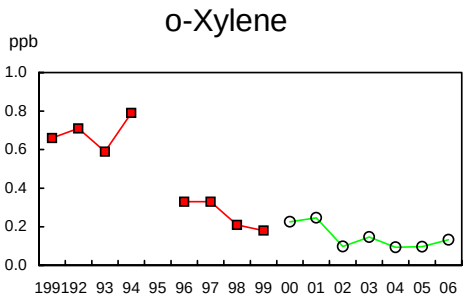


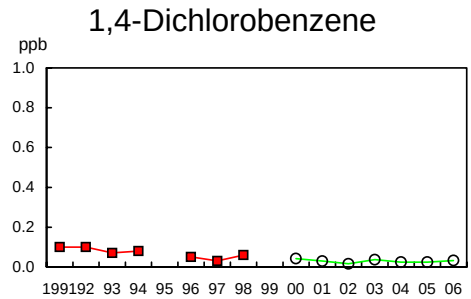












The Delaware Air Toxics Assessment Study (DATAS)

The monitoring for Phase I of DATAS was completed as of June 30, 2005. It includes a full year of measured air toxic concentrations at five locations, a risk assessment of those concentrations, an emission inventory, and a prototype study of modeling performance.

The full report is available at http://www.awm.delaware.gov/Info/Regs/DATAS.htm

Currently, the modeling for Phase II of DATAS is projected to be completed in 2007 and the subsequent report will include results of the statewide modeling effort and a risk assessment of the modeled concentrations. Further analysis of the monitoring and inventory data will also be included in the Phase II report.

Whereas the monitored data represent only five sites in Delaware, the air dispersion modeling effort will generate ambient concentrations at a finer resolution throughout Delaware, providing a comprehensive picture of air toxics. In order to have confidence in the model's ability to accurately predict ambient concentrations, the modeling results will be compared to the monitored data. Adjustments to the model assumptions and inputs, including reassessment of the emission inventory, may be necessary based on comparability with the monitored results.

The AQM has proposed a Risk Management Plan (RMP) as part of its Air Toxics Strategic Plan that was submitted to EPA Region III in February 2005. The AQM proposes to establish a stakeholder process to develop (1) action levels based on risk and (2) a process for addressing risks that require action. Depending on the risk drivers and the sources contributing most to the risk, the process will develop a set of solutions, which may include regulatory and/or non-regulatory options to reduce risk. In addition, the results of DATAS will assist the permitting process base its decisions on cumulative impacts. The modeling tool developed through DATAS will be used with future inventories to periodically assess ambient concentrations of air toxics in the future.

Enhanced Delaware Air Toxics Assessment Study (E-DATAS)

Through funding opportunities provided by the National Air Toxics Monitoring Program – Community Assessments, the AQM was able to expand the initial monitoring work that was performed during the 2003 DATAS effort.

During the development, implementation, and conclusion of this enhanced study, AQM strived to better understand the suite of pollutant sources that are impacting the air quality at the Martin Luther King Station (MLK), located in Wilmington, Delaware.

Through collaborative partnerships with University of Delaware and Duke University research

teams, an ambient air monitoring study, defined as the Enhanced Delaware Air Toxics Study (E-DATAS) was conducted at the MLK. The study began in April 2005 and continued through February 2006.

Specifically, E-DATAS was designed to:

- Characterize the seasonal ambient variability of ambient aerosols of aerodynamic diameters of 50, 110, 220, 440, and 770 nm at the MLK site. Real-time measurements were performed during four, one-month intensive efforts using the Rapid Single-particle Mass Spectrometer, version 3 (RSMS-3).
- Implement an approach in which selected industry within a 10-km radius of the MLK could be characterized according to their ambient aerosol contribution. Data obtained during this effort was vital to better identifying a source's contribution to the ambient air composition at the MLK.
- Study the spatial and seasonal variability of target ambient compounds (formaldehyde, chromium species, particulate matter, and ozone) using both research-specific and commercially available technology to perform mobile, real-time ambient measurements within the Wilmington area. These measurements were performed during four, one-week intensive efforts that were coordinated with the aerosol measurements.
- Utilize and integrate into E-DATAS many of the federal- and state-run ambient measurements being performed at the MLK. For this study, particulate, carbon monoxide, nitric oxide, and wind measurements were incorporated into E-DATAS.
- Develop efficient, effective, and long-term partnerships with the research community, which will provide value-added data to enhance AQM' and the public's understanding of the state of Delaware's air quality. E-DATAS clearly signifies the importance of developing these partnerships, as this field application would not have been performed otherwise.

Project Conclusions

At the conclusion of the E-DATAS field monitoring efforts an enormous dataset was established for ambient aerosol characterization at the MLK with over 500,000 ambient aerosol particles being analyzed with the RSMS-3. Additionally over 61,000 aerosol size distributions were collected via the mobile monitoring effort with 42,426 data points being collected for formaldehyde, and 26,843 data points collected for chromium.

The project conclusions that are summarized below are organized by monitoring activity, (fixed-site aerosol monitoring vs. mobile monitoring)

Fixed-Site Aerosol Monitoring

With over 500,000 ambient aerosol particles, data had to be analyzed in clusters of 40,000

particles. Data collected from each of the four monitoring intensives was kept separate from other intensives. For the MLK, data were separated into 16 chemical composition classes: OCANS (organic carbon, ammonium nitrate, ammonium sulfate secondary aerosol), ammonium nitrate, potassium, EOC, amine, sodium, potassium with sodium, iron, iron with cerium/lanthanum, lead, zinc, zinc with lead, tin/antimony, lithium, vanadium, and other metals.

From the analysis of this dataset, AQM has the following understanding of the source contributions at the MLK.

- Air quality at the MLK has a regional characteristic.
- The MLK is impacted by wood and biomass burning. There is a slight bias toward wind directions for the northwest where the greatest nearby residential population exits. There is also a slight bias toward the nighttime, consistent with residential wood burning.
- The MLK is impacted by diesel vehicle exhaust, as indicated by the EOC measurements. The slight enhancement of EOC when the wind is from the east may indicate a contribution from industrial combustion sources. Also, diesel emissions from the nearby DART depot impact the MLK.
- The MLK measurements have signatures from stack emissions where aliphatic amines have been added during the scrubbing process used to remove SO2 from the effluent.
- Multiple local industrial combustion processes to the east and southwest contribute to the MLK signature.
- Signatures from the Delaware City Refinery, and the Delmarva Edgemoor Power Plant were detected in the ambient air sampled at the MLK.
- CitiSteel emissions impact the MLK. Bag sampling at the CitiSteel site confirm this signature and association.
- Emissions from oil powered boilers impact the MLK. There is a strong time of day preference for these impacts, strongest during the early morning hours, as oil powered boilers are firing at the start of the day.
- Signatures from particles emitted from large ships were measured at the MLK. Wind dependence (110°) indicates that the Port of Wilmington impacts the MLK ambient measurements.
- In broad estimates, the Wilmington aerosol is characterized as follows:
    - Secondary aerosol of regional origin constitutes about 38% of $PM_{1.}$
    - Secondary aerosol of local origin constitutes about 27% of PM_1.
    - Biomass burning contributes about 14% of PM_1.
    - Primary particulate emissions from vehicular traffic contribute about 8% of $PM_{1.}$
    - Primary particulate emissions from local industrial sources contribute about 13% of $PM_{1.}$

Mobile Monitoring

Through implementation of the Duke University Mobile Laboratory, over 130,000 data points

were measured during the E-DATAS to characterize the spatial, temporal and seasonal variability of water-soluble hexavalent and trivalent chromium, formaldehyde, ozone, and particulate matter.

The analysis of these data indicate the following significant conclusions:

- Aerosol number concentration, chromium IV, and particulate matter less than or equal to 0.27 micron diameter, varied significantly by location.
- The variability in formaldehyde and ozone concentrations during the summer 2005 campaign was lower in comparison to the aerosol concentration. Since both formaldehyde and ozone are either partially or fully produced by photochemistry, this result is expected.
- Only formaldehyde showed a seasonal trend with concentrations being highest during the spring and summer, while the winter campaign had the lowest concentration.
- PM0.27 shows a seasonal trend similar to that of formaldehyde, but the trend is largely obscured by the strong variability in the data.
- Comparison of the mobile data to the federal- / state-run network indicates:
    - Comparisons with CO and NOx concentrations measured at the central site do not correlate well with the mobile results for formaldehyde, PM0.27, or chromium IV.
    - Both formaldehyde and PM0.27 correlate well with the PM10 and PM2.5 measured at the central site. This suggests that PM0.27 and formaldehyde are influenced by long-range sources.
    - Formaldehyde and PM0.27 show a positive correlation with temperature, suggesting the photochemical activity.

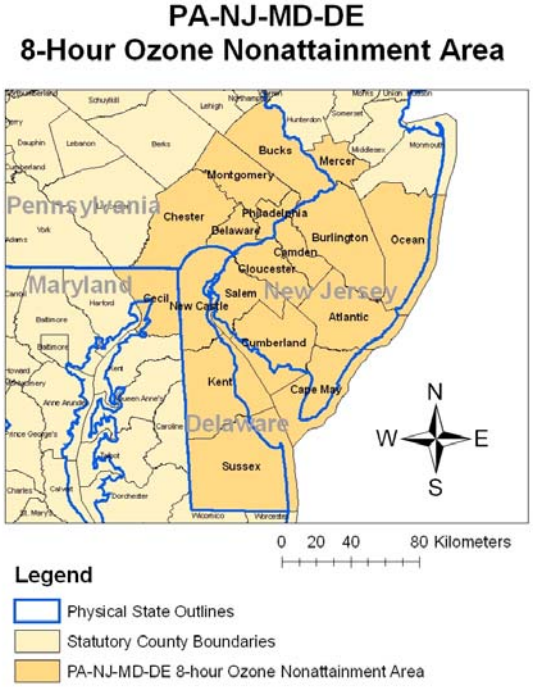
III. SOURCES OF POLLUTION

OZONE

EMISSIONS INVENTORY

In 1997, the U.S. Environmental Protection Agency (EPA) promulgated a revised National Ambient Air Quality Standard (NAAQS) for ground-level ozone at a concentration of 0.08 ppm averaged over eight hours. The new standard went into effect on June 15, 2004 and supersedes the 1-hour ozone standard of 0.12 ppm. All three of Delaware's counties (Kent, New Castle, and Sussex) have been designated non-attainment for the 8-hour standard based on 2000-2002 monitoring data. All three counties are included in the Philadelphia-Wilmington-Atlantic City non-attainment area which is listed as a "moderate" area with an attainment date of June 15, 2010.

EPA established calendar year 2002 as the base year inventory for the new ozone standard, thus requiring states with 8-hour ozone non-attainment areas to submit as part of their State Implementation Plan (SIP) a comprehensive, accurate, and current base year inventory of actual emissions of ozone-causing pollutants. Ozone-causing pollutants, also known as ozone precursors, include volatile organic compounds (VOCs), oxides of nitrogen (NOx), and carbon monoxide (CO).



What is an emissions inventory?

The emission inventory is a tool used to determine the amount of air pollution released from various air emission sources in a given geographic area. The inventory identifies the source types present in an area, the amount of each pollutant emitted, the types of processes and control devices employed, and other information.

Why are emissions inventories necessary?

The Clean Air Act Amendments (CAAA) of 1990 require states with nonattainment areas to submit a comprehensive, accurate, current inventory of actual emissions of ozone precursors from all sources every three years since 1990. These consecutive inventories provide the historic documentation needed to assist in demonstrating an area's progress in emission reduction and towards attainment of the NAAQS for ozone.

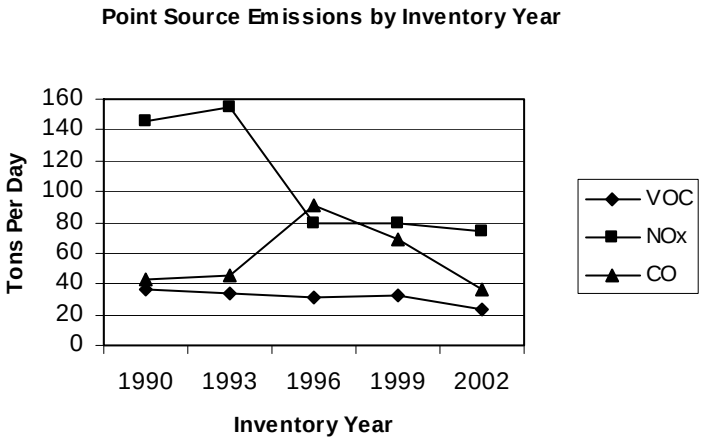
How are these inventories used?

Emission inventories can serve many purposes. They are the basis of overall air quality management planning, and are used in ambient dispersion modeling and analysis, control strategy development, and in screening sources for compliance investigations. Together with ambient monitoring data, inventory emission estimates are used to understand changes and trends in air quality.

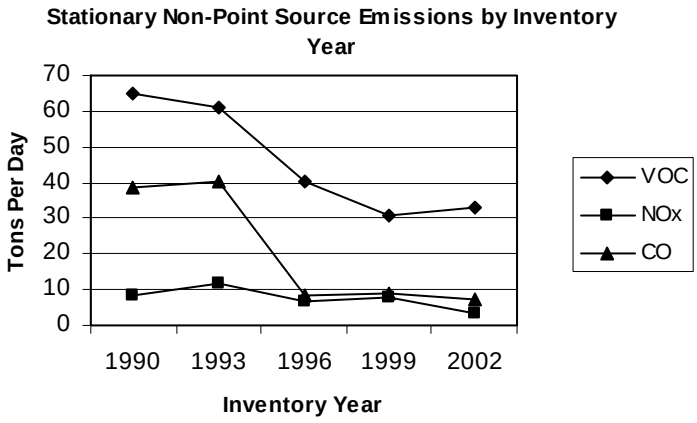
CHARACTERIZATION OF OZONE PRECURSOR EMISSIONS SOURCES

Sources of air emissions are classified into five sectors by the nature of the emissions and the physical characteristics of the emitter. These five sectors are described below and are accompanied with graphics depicting emissions from 1990 through 2002 for each ozone precursor.

Point sources are defined for emission inventory purposes as industrial, commercial, or institutional plants/operations that emit VOCs of 10 tons per year (TPY) or greater and/or NOx or CO emissions of 25 TPY or greater. Owners or operators of about 100 such sources in Delaware are required to report annually the quantity and type of emissions. Refineries, chemical manufacturing facilities, power plants, auto assembly plants, solid waste landfills, and large building heating systems are included in this sector.



Stationary non-point sources are sources that fall below the point source emission threshold definitions given above and are thus not practical to identify individually for emission inventory purposes. The quantity and type of emissions from these sources are estimated by using established emission factors and appropriate activity data from the area. For example, emissions from service stations can be estimated based on the number of such facilities in the area and knowledge of the amount of gasoline sold. Print



shops, dry cleaners, painting operations, degreasing and other solvent-using operations, small building heating, and outdoor burning are a few of the operations included in this sector.

Mobile sources are usually divided into two sectors: on-road and off-road.

On-road mobile sources consist of automobiles, trucks, motorcycles, and other vehicles traveling on roadways in the nonattainment area. The MOBILE6 model developed by EPA estimates emission rates for VOCs, NO_x, and CO; these rates combined with vehicle miles traveled, are then used to develop estimates of the quantity of emissions produced by this source. Emissions from the tailpipe of vehicles, as well as emissions due to evaporation of gasoline and other fluids, are estimated.

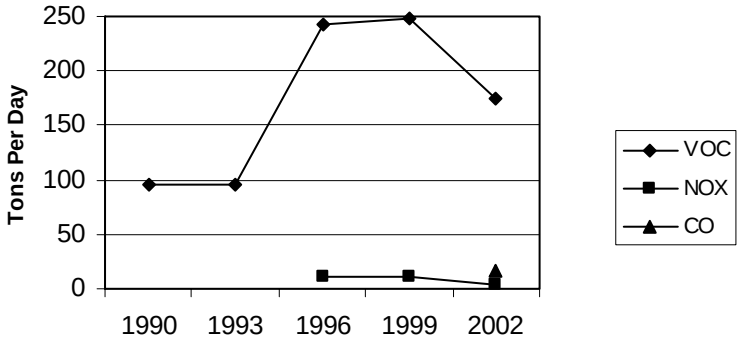
Off-road mobile sources include commercial, military, and general aircraft, marine vessels, recreational boats, railroad locomotives, and a very broad subcategory that includes everything from construction equipment, forklifts, and farm tractors to lawn mowers, chain saws, and leaf blowers. Most engines in this sector have no emission controls and are considered high emitters of VOCs. Emissions are estimated primarily through the use of EPA's NONROAD model.

Natural sources include plant life in the area, such as crops, trees, grasses, and other vegetation. Microbial activity within soil is a source of NOx and CO. The BEIS3.12 model is used to estimate the quantity and type of emissions from

On-road Mobile Source Emissions by Inventory Year

Off-road Mobile Source Emissions by Inventory Year

Natural Source Emissions by Inventory Year



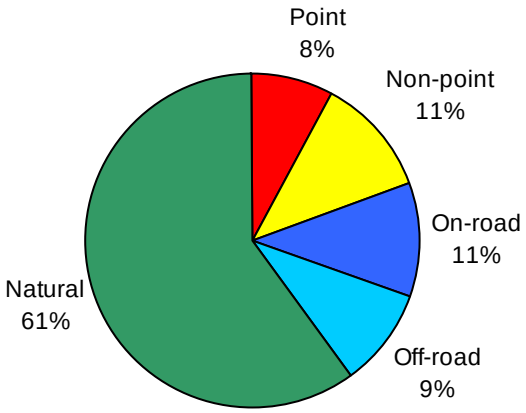
* Nox Emissions not estimated for 1990 and 1993
* CO Emissions not estimated for 1990 thru 1999

vegetation making use of tools such as satellite imaging to develop county specific land use data. While biogenic sources do emit VOCs into the atmosphere that may contribute to ozone formation, they also remove significant amounts of CO, SO_2, NOx, O_3, and PM_{10} from the air, and cool the air through shade and transpiration, thus reducing pollution from other sources. Finally, lightning is a source of NOx.

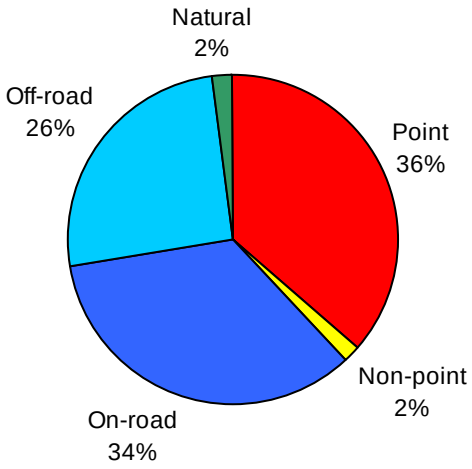
2002 Statewide Peak Ozone Season Daily Emissions			
Source Category	Pollutant Emissions (TPD)		
	VOC	**NOx**	**CO**
Point	23.3	74.1	36.8
Non-point	33.0	3.2	7.2
Mobile on-road	32.4	69.0	396.9
Mobile off-road	26.8	52.8	267.1
Natural	173.9	3.9	16.1

Emissions by Source Category.

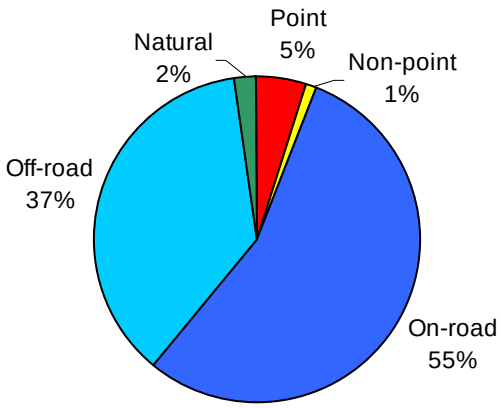
2002 Statewide VOC Emissions by Source Category



2002 Statewide NO_X Emissions by Source Category



2002 Statewide CO Emissions by Source Category



SULFUR DIOXIDE (SO_2) AND PARTICULATE MATTER (PM_{10} and $PM_{2.5}$)

As a result of recent findings describing the adverse health effects associated with fine particulates, and the establishment of a fine particulate national ambient air quality standard, the Emission Inventory Development (EID) Program has undertaken the creation of a complete 2002 particulate inventory, including both primary particulate and particulate precursors.

Primary particulate emissions consist of both solid particles of various sizes and aerosols. The solid particles can be delineated by size, such as $PM_{2.5}$, which designates particles with a diameter of 2.5 microns or less. PM_{10} defines particles with a diameter of 10 microns or less, and thus includes $PM_{2.5}$ as well as particles that range from 2.5 microns up to 10 microns. Since EPA has only recently established an air quality standard specifically for $PM_{2.5}$, emission estimation methodologies and emission factors are currently lacking for some source categories.

Secondary particulate emissions are precursors that react in the atmosphere to produce fine particles away from the emitting source. The precursors include sulfur dioxide (SO_2), nitrogen oxides (NOx), ammonia, and certain organic and inorganic compounds. Since NOx and VOCs are already inventoried due to their contribution to ground-level ozone formation, the inventory program only adds SO_2 and ammonia to its list of pollutants to be inventoried from all sources.

The majority of PM_{10} emissions are primary particulate, with a large proportion being fugitive emissions, usually dust particles from non-point and natural sources. Significant contributions also come from mobile, non-point and point source fuel combustion.

The profile for $PM_{2.5}$ is significantly different, with the vast majority of emissions being secondary emissions. Sulfates and nitrates, which are secondary compounds of $PM_{2.5}$, are expected to comprise almost two-thirds of the total inventory. Roughly one-third of the $PM_{2.5}$ inventory is comprised of emissions from combustion sources. Only a very small amount, approximately 5%, is due to primary fugitive emissions, mostly dust.

Sulfur dioxide is largely a result of fossil fuel combustion, particularly from coal and diesel fuel. Electric utility generation and refineries are by far the largest SO_2 emission sources. Motor vehicle fuel combustion is also a significant source of SO_2, although on a much smaller scale than stationary source fuel combustion.

HAZARDOUS AIR POLLUTANTS (HAPs)

In addition to ozone precursors, and particulate and its precursors, Delaware also has regulations that address the emissions of air toxics. The Permitting & Compliance group of the Air Quality Management Section maintains air permits on various processes that emit air toxics. Specific toxic chemicals, called Hazardous Air Pollutants (HAPs), are regulated under these permits. The Clean Air Act mandates that EPA set national standards for HAPs. These standards are based on specific emission source types, and are called Maximum Achievable Control Technology (MACT) standards.

For the first time, the EID Program developed a comprehensive air toxics inventory for 2002 in support of the Delaware Air Toxics Assessment Study (see page 36). All sources (point, non-point, on-road mobile, and off-road mobile) were included in the toxics inventory. Additional information on emissions of air toxics is contained in the annual Delaware Toxics Release Inventory Report (see References). These inventories can be used to track progress associated with implementing the MACT standards.

IV. POLLUTION CONTROL/PREVENTION

CLEAN AIR ACT AMENDMENTS OF 1990 AND OZONE NAAQS

The Clean Air Act Amendments of 1990 require EPA, states, and cities to implement a series of programs that will further reduce emissions of VOCs and NO_X from cars, fuels, industrial and chemical facilities, power plants, and consumer and commercial products among other sources, to attain the ozone NAAQS. Cleaner cars and fuels, new kinds of gasoline nozzles, enhanced vehicle inspection, and other programs along with new control strategies have been implemented in the past decade or so, and additional control measures will be phased in over the next decade.

The Philadelphia-Trenton-Wilmington Consolidated Metropolitan Statistic Area (CMSA) was classified as severe non-attainment area under the 1-hour ozone NAAQS (0.12 ppm). Delaware's Kent and New Castle Counties fell into this several non-attainment area, while Sussex County was designated separately as a marginal non-attainment area. To attain the 1-hour ozone standard, Delaware fulfilled the following strategies and control programs that were required by the 1990 CAAA:

- submission and implementation of an ozone air quality SIP;
- development of a periodic emissions inventory for ozone precursors every three years;
- a 15% net-of-growth reduction in VOC emissions by 1996 and a 3% reduction in VOC and/or NOx emissions each year after 1996 until 2005;
- development of Rate-of-Progress Plans (RPPs) for 1996, 1999, 2002, and 2005 to achieve the above VOC and/or NO_x emission reductions;
- a demonstration that transportation plans conform to ozone air quality SIP;
- an enhanced vehicle inspection-and-maintenance program;
- reformulated gasoline;
- clean, alternatively fueled vehicles;
- demonstration using EPA-recommended modeling methods that the 1-hour ozone standard could be attained in 2005;
- collection of additional pollutant and meteorological data to support modeling efforts;
- a program to prevent the addition of new large sources of emissions from increasing total emissions;
- new emissions controls on small business;
- new controls on fugitive emissions;
- reasonably available control technology (RACT) for sources of VOC or NO_x emissions; and
- enhanced monitoring by industrial sources; and maximum achievable control technology on large sources of hazardous air pollutants, some of which are VOCs.

In 1997, EPA revised the 1-hour ozone NAAQS (0.12 ppm) to an 8-hour standard of 0.08 ppm. In June 2004, EPA designated all three counties in Delaware as moderate non-attainment area, as a part of Philadelphia-Wilmington-Atlantic City PA-NJ-MD-DE moderate non-attainment area,

under the 8-hour ozone NAAQS. In June 2005, EPA revoked the 1-hour ozone standard. However, the 1-hour ozone standard stays valid in Delaware as required by its Regulation 3 Governing Control of Air Pollution. All control strategies and programs listed above stay in effect in Delaware, as required by the Clean Air Act (CAA) and Delaware's regulations.

PROGRESS TOWARD ATTAINMENT OF THE NAAQS FOR OZONE

The 1990 Clean Air Act Amendments (CAAA) contain provisions for the attainment and maintenance of the ozone NAAQS. State implementation plans (SIP) must be developed in designated nonattainment areas. Plan requirements vary depending on the severity of the individual area's air pollution problem. Under the 1-hour ozone standard, New Castle and Kent Counties have been designated to be in severe nonattainment while Sussex County has been placed in marginal nonattainment status.

One key requirement of the CAAA for moderate and above ozone nonattainment areas is the achievement of Reasonable Further Progress (RFP) toward the attainment of the NAAQS. States must demonstrate RFP by achieving at least a 15 percent reduction of VOC emissions from 1990 levels by 1996. In addition, states must offset any growth in emissions projected from 1990 to 1996. A three percent per year reduction of VOC and/or NO_x emissions is required between 1997 and 2005. The year 2005 is the year for which severe nonattainment areas must attain the 1-hour ozone standard.

Progress toward attainment of the NAAQS in the year 2005 is measured by periodic emission inventories conducted every three years, beginning in 1993. Actual air emission data are inventoried for reactive VOCs, NO_x, and CO from point, area and mobile sources.

Point sources, as defined for the 1990 base year and successive inventories, are those facilities/plants/activities that have actual emissions greater than or equal to at least one of the following: 10 tons per year VOC, 100 tons per year NO_x, or 100 tons per year CO. Detailed plant, point and process data is maintained by each point source. Area sources represent collections of many small air pollutant emitters existing within a specified geographical area. Because non-point sources are too small and/or too numerous to be surveyed and characterized individually, their emissions must be estimated collectively. Mobile sources are represented by all forms of transportation commercial/recreational/private, as well as portable implements and tools powered by internal combustion engines. Emissions for mobile sources are estimated through primary data, computer modeling and collective estimates.

In 1995, DNREC submitted its 15 percent VOC reduction SIP for 1996 to the EPA. It targeted reductions through multiple control strategies including gasoline vapor collection, low volatility coatings and solvents, and controlling leaks in manufacturing processes. To further reduce VOCs, Delaware implemented statewide use of reformulated gasoline and an open burning ban in Kent and New Castle Counties during the months of June, July, and August.

Delaware submitted its 1999 RFP plan to the EPA in December 1997, and amended it in June 1999. In addition to continuing the VOC emissions controls in the 15 Percent Plan, the 1999 RFP (as amended) was designed to achieve significant NO_x reductions through implementing controls over a variety of NO_x sources, especially large industrial sources. Afterwards, Delaware submitted its 2002 RFP plan and 2005 RFP plan in February 2000 and December 2000, respectively, implementing additional control programs over a wide range of VOC and NOx emission sources. Many of those control programs were implemented along with other states within the northeast Ozone Transport Region (OTR).

Delaware's efforts in controlling ozone problem have made remarkable progresses. Both VOC and NOx emissions in Delaware have been reduced significantly since 1990. Delaware's 1993, 1996, 1999 and 2002 periodic emission inventories have demonstrated that all RFP emission reductions under the 1-hour ozone standard were achieved. In 2003, 2004 and 2005, ambient monitors in all three counties in Delaware recorded ozone concentrations in compliance with the 1-hour ozone standard, indicating that Delaware attained the 1-hour ozone standard in 2005. All VOC and NOx emission control programs in Delaware stay in effect for maintaining this attainment status.

Now, Delaware, as well its neighboring states, is focusing on the new 8-hour ozone standard, which must be attained in 2010. In September 2006, Delaware submitted to EPA the Reasonably Available Control Technology (RACT) SIP revision. In June 2007, Delaware submitted to EPA the RFP and Attainment Demonstration SIP revision. Both SIP revisions were required by the CAAA under the 8-hour standard. In addition to continuing all control measures implemented under the 1-hour ozone standard, Delaware has committed to additional and/or improved (i.e., revised) control measures to further reduce VOC and NOx emissions in the years to come. It is anticipated that all those efforts will further improve Delaware air quality with respect to ozone.

OTHER POLLUTANTS

The Clean Air Act Amendments of 1990 also include a number of sections devoted to air pollutants besides ozone. Requirements for other pollutants include:

- Reduction of sulfur dioxide (SO_2) emissions nationally to reduce acid deposition; the goal is a reduction of 10 million tons per year from 1980 levels. This represents a reduction of approximately 40% by the year 2000. There is also a national cap on major point-source emissions after the year 2000.
- Expansion of Maximum Available Control Technology standards to sources of toxic emissions not previously covered. The expanded standards will result in reduced emissions of benzene from wastewater treatment plants, chrome from cooling towers, and tetrachloroethylene from dry cleaning and chrome plating.
- Implementation of Title V of the Clean Air Act Amendments by establishing a new operating permit program for all major stationary sources of air pollutant emissions. This program will ensure that both industry and the public are knowledgeable as to the rules and regulations that all major stationary sources are required to meet.

Delaware has relevant control programs that fulfill the above requirements.

V. WHAT YOU CAN DO

Air pollution is a worldwide problem. No political boundaries stop the flow of polluted air. No humans have been able to retrieve pollutants once they have been released. Because air pollutants spread rapidly, almost instantaneously, polluters rarely feel affected by their decision to pollute.

By choosing to act, each person can reduce air pollution and make a difference in the environment. Since the primary sources of air pollution are from vehicular transportation and energy production, the main thing you can do is ***conserve energy and use alternative forms of transportation***.

Reduce pollution in the following manner:

- Limit single passenger trips in the car, plan your trips, form a car pool.
- Use public transportation.
- Walk or bike whenever possible.
- Turn off lights and appliances not in use.
- Recycle everything you can and use products made from recycled materials.
- Use environmentally friendly household products.
- Keep your automobile well tuned and maintained.
- Be careful not to spill gasoline when filling up your car, boat, or lawn and garden equipment.
- Seal containers containing household cleaners, workshop chemicals and solvents, and garden chemicals to prevent volatile organic chemicals from evaporating into the air.

You can also stay informed by reading and listening for information on air quality data, legislation, and regulations. For more air quality information and what you can do, visit our website: *http://www.awm.delaware.gov/AirQuality.htm.*

APPENDIX A - Monitoring Methods

Carbon Monoxide (CO)
Carbon monoxide is measured by infrared absorption photometry. Air is drawn continuously through a sample cell where infrared light passes through it. Carbon monoxide molecules in the air absorb part of the infrared light, reducing the intensity of the light reaching a light sensor. The light is converted into an electrical signal related to the concentration of carbon monoxide in the sample cell.

Nitrogen Dioxide (NO_2)
Nitrogen oxides are measured using the chemiluminescence reaction of nitric oxide (NO) with ozone (O_3). Air is drawn into a reaction chamber where it is mixed with a high concentration of ozone from an internal ozone generator. Any NO in the air reacts with the ozone to produce NO_2. Light emitted from this reaction is detected with a photo multiplier tube and converted to an electrical signal proportional to the NO concentration. Nitrogen dioxide (NO_2) must be measured indirectly. Total nitrogen oxides (NO_X) are measured by passing the air through a converter where any NO_2 in the air is reduced to NO before the air is passed to the reaction chamber. By alternately passing the air directly to the reaction chamber, and through the converter before the reaction chamber, the analyzer alternately measures NO and NO_X. The NO_2 concentration is equal to the difference between NO and NO_X.

Ozone (O_3)
Ozone is measured by ultraviolet absorption photometry. Air is drawn through a sample cell where ultraviolet light (254 nm wavelength) passes through it. Light not absorbed by the ozone is converted into an electrical signal proportional to the ozone concentration.

In Delaware, the ozone season runs from April 1 to October 31 during which monitors are in operation at six sites (see Delaware monitoring network description). Monitoring continues at Bellefonte and Summit Bridge year-round.

Particulate Matter - Fine ($PM_{2.5}$)
$PM_{2.5}$ is sampled by drawing air through a specially designed inlet that excludes particles larger than 2.5 microns in diameter. The particles are collected on a Teflon® microfiber filter that is weighed to determine the particulate mass. The normal sampling schedule is 24 hours every third day, however, at one site (Wilmington-MLK) samples are collected for 24 hours every day.

Particulate Matter (PM_{10})
PM_{10} is sampled continuously using a tapered element oscillating microbalance (TEOM). Air is drawn through a specially designed inlet that excludes particles larger than 10 microns in diameter. Particle accumulation causes changes in the microbalance oscillation which are recorded by the instrument.

Sulfur Dioxide (SO_2)
Sulfur dioxide is measured with a fluorescence analyzer. Air is drawn through a sample cell where it is subjected to high intensity ultraviolet light. This causes the sulfur dioxide molecules in the air to fluoresce and release light. The fluorescence is detected with a photo multiplier tube and converted to an electrical signal proportional to the SO_2 concentration.

Lead
A large volume of air is drawn through a glass fiber filter (Hi-vol method). Part of the filter is removed and chemically extracted. This is followed by laboratory analysis using atomic absorption spectrometry to determine the lead concentration.

Acid Rain
Acidity is reported as pH, which is a measure of hydrogen ion concentration. The scale is logarithmic with a pH of 7.0 being neutral, pH 10.0 highly basic and pH 1.0 highly acidic. Clean precipitation is approximately pH 5.6.

Weekly precipitation samples are collected at the Ommelanden range. This monitor is for wet deposition only; dry deposition is not measured in Delaware. In the past, there was a second monitoring site in Georgetown. This site was terminated due to questions of site quality (too close to roadways) and restrictions on resources. Samples are analyzed for pH and conductivity at the Air Surveillance lab ("field" measurements). From 1983 through April 1995, the samples were mailed to a contractor for detailed chemical analysis for pH, conductivity, and ion species; this has been discontinued due to lack of financial support by the EPA.

Community Air Toxics
There are no EPA "reference" methods for monitoring ambient air for VOCs. In Delaware's program from 1991 through 1999, samples were taken on sorbent tubes once per week, rotating Monday through Thursday, for 24 hour intervals. The tubes were analyzed by the DNREC Environmental Services Laboratory using a gas chromatograph/mass spectrometer (GC/MS). Quality control measurements included collocated samplers, travel and laboratory blanks, spiked tubes, internal and various calibration standards. This method was replaced in 2000 by EPA Method TO15a, which collects 24-hour samples once every six days using stainless-steel canisters followed by GC/MS analysis.

Heavy metals are collected by drawing a large volume of air through a glass-fiber filter (Hi-vol method). The filters are extracted using method IO3.5. Samples are collected for 24 hours once every six days.

Carbonyls are collected by drawing low volume of air through a 2,4-Dinitrophenylhydrazine Coated trap for 24 hours. The samples are analyzed using method TO-11A. Samples are collected once every six days.

APPENDIX B - Definitions, References, and Contacts

Ambient Air: Generally, the atmosphere; usually refers to the troposphere**.**

Annual Arithmetic Mean: The numerical average of the data for the year.

Annual Geometric Mean: The geometric average of the data for the year (the nth root of the product of n numbers).

Attainment: EPA designation that an area meets the NAAQS.

24-hour Average: The average concentration for a 24-hour period.

CAA: Clean Air Act

CAAA: Clean Air Act Amendments of 1990.

CMSA: Consolidated Metropolitan Statistical Area

Chemiluminescence: Visible light produced by chemical reaction.

Exceedance: An incident occurring when the concentration of a pollutant in ambient air is higher than the NAAQS.

Fluorescence: The production of light in response to the application of radiant energy such as ultraviolet rays.

Infrared: Lying just beyond the red end of the visible electromagnetic spectrum.

MSA: Metropolitan Statistical Area

NAAQS: National Ambient Air Quality Standard, set by EPA to protect human health and welfare.

NAMS: National Air Monitoring Stations

Nonattainment: EPA designation that an area does not meet the NAAQS.

OTR: Ozone Transport Region.

PAMS: Photochemical Assessment Monitoring Stations

PEI: Periodical Emission Inventory

Photometry: The measurement of the intensity of light.

Photomultiplier: A device that converts light into an electrical current, amplifying it in the process.

ppb: Parts per billion by volume.

ppm: Parts per million by volume.

Precursor: A substance that is the source of, or aids in the formation of, another substance.

RACT: Reasonably Available Control Technology.

RFP: Reasonable Further Progress.

SIP: State Implementation Plan.

SLAMS: State and/or Local Air Monitoring Stations

SPMS: Special Purpose Monitoring Stations

Spectrometry: The measurement of electromagnetic wavelengths (spectra**).**

Troposphere: The region of the atmosphere nearest to the earth in which temperature generally decreases with height.

Fg/m^3: Micrograms per cubic meter.

Ultraviolet: Lying just beyond the violet end of the visible electromagnetic spectrum.

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The Delaware 2005 Rate-of-Progress Plan for Kent and New Castle Counties. Delaware Department of Natural Resources and Environmental Control, Division of Air and Waste Management, Air Quality Management Section, Dover, Delaware, December 2000.

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Some Air Quality Related World Wide Web Sites

AIRSData - Access to national and state air pollution concentrations and emissions data
www.epa.gov/air/data/index.html

American Lung Association
http://lungsusa.org

Delaware State Climatologist
www.udel.edu/leathers/stclim.html

Delaware Valley Regional Planning Commission (daily ozone forecasts)
http://www.dvrpc.org/AQPartnership/index.htm

Mid-Atlantic/Northeast Visibility Union - Regional Planning for Improved Visibility
www.manevu.org

State of Delaware Air Quality Management Section current hourly monitoring data
www.dnrec.state.de.us/air/aqm_page/airmont/air.asp

US National Oceanic and Atmospheric Administration, Environmental Research Laboratories,
www.arl.noaa.gov

USEPA Emission Factor and Inventory Group
www.epa.gov/ttn/chief

USEPA Office of Air and Radiation, Air Trends reports
http://www.epa.gov/airtrends/reports.html

USEPA Office of Air Quality Planning and Standards “AirNow” - ozone maps, real-time data
www.epa.gov/airnow/

USEPA Office of Transportation and Air Quality (formerly Office of Mobile Sources)
www.epa.gov/oms

USEPA Region III Air Protection Division
www.epa.gov/reg3artd

USEPA Technology Transfer Network (TTN Web)
www.epa.gov/ttn

LIST OF CONTACTS

Department of Natural Resources and Environmental Control
Division of Air and Waste Management
Air Quality Management Section

Administration	302-739-9402
Administrator	Ali Mirzakhalili
Air Surveillance Branch	302-323-4542
715 Grantham Lane	
New Castle, DE 19720	
Branch Manager	Joe Martini
Program Manager	*Vacant*
Air Monitoring Data	Betsy Frey
Air Toxics Data	Terry Meade
Engineering and Compliance Branch	302-323-4542
715 Grantham Lane	
New Castle, DE 19720	
Branch Manager	Paul Foster
Planning Branch	302-739-9402
156 South State Street	
Dover, DE 19901	
Branch Manager	Ron Amirikian
Emissions Inventory Development	
Program Manager	David Fees
Point Sources	John Outten
Stationary Area Sources	David Fees
Mobile Sources (on- and off-road)	David Fees
State Implementation Plan (SIP) - Regulations and Planning	
Program Manager	Ron Amirikian
Ozone SIP Development	Frank Gao
$PM_{2.5}$ SIP Development	Jack Sipple
Mobile Source Controls	Phillip Wheeler

EXHIBIT 6

Calculating Greenhouse Gas Emissions with the Waste Reduction Model

US EPA User's Guide for WARM

http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_UsersGuide.html
Last updated on Thursday, December 21st, 2006.

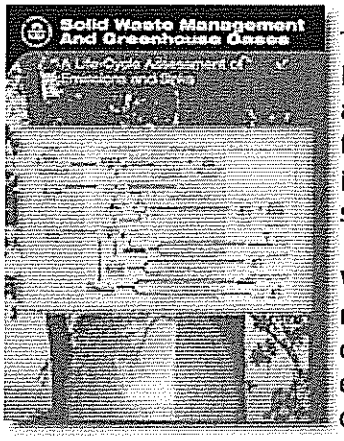
Climate Change - Waste

Tools ReCon WARM DGC

User's Guide for WARM

Calculating Greenhouse Gas Emissions with the WAste Reduction Model

What is the WAste Reduction Model?



The WAste Reduction Model (WARM) was created by the U.S. Environmental Protection Agency (EPA) to help solid waste planners and organizations estimate greenhouse gas (GHG) emission reductions from several different waste management practices. WARM is available in a Web-based calculator format and as a Microsoft Excel© spreadsheet. Both versions of WARM are available on EPA's Web site.

WARM calculates GHG emissions for baseline and alternative waste management practices, including source reduction, recycling, combustion, composting, and landfilling. The model calculates emissions in metric tons of carbon equivalent (MTCE) and metric tons of carbon dioxide equivalent (MTCO2E) across a wide range of material types commonly found in municipal solid waste (MSW).[1] In addition, the model calculates energy use for each of the options, and the Microsoft Excel© version allows users to report results by year, by gas, and by year and gas. These options facilitate reporting to the Department of Energy's 1605(b) program.

The user can construct various scenarios by simply entering data on the amount of waste handled by material type and by management practice. WARM then automatically applies material-specific emission factors specific for each management practice to calculate the GHG emissions and energy savings of each scenario. Several key inputs, such as landfill gas recovery practices and transportation distances to MSW facilities, can be modified by the user.

NOTE	ReCon and WARM were developed for purchasers and waste managers, respectively. ReCon calculates the benefits of alternative recycled content purchasing decisions. WARM, on the other hand, calculates the benefits of alternative end-of-life waste management decisions. Both tools calculate the benefits of an alternative scenario versus a business-as-usual scenario. The WARM and ReCon tools are based on a life-cycle approach, which reflects emissions and avoided emissions upstream and downstream from the point of use. As such, the emission factors provided in these tools provide an account of the net benefit of these actions to the environment. This life-cycle approach is not appropriate for use in inventories because of the diffuse nature of the emissions and emission reductions contained in a single emission factor.

The GHG emission factors were developed following a life-cycle assessment methodology using

estimation techniques developed for national inventories of GHG emissions. EPA's report *Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks* (EPA530-R-06-004) describes this methodology in detail. For a free copy of this report, follow this link or call National Service Center for Environmental Publications (NSCEP) at 1-800-490-9198.

For some material types, WARM indicates that recycling reduces more GHG emissions than does source reduction. This is because recycling is assumed to displace 100 percent virgin inputs, whereas source reduction is assumed to displace some recycled and some virgin inputs. For more information, please see "Why Recycling Some Materials Reduces GHG Emissions More than Source Reduction." WARM was recently revised to include tires as a new material type.

Material Types Recognized by WARM		
Aluminum Cans	Branches	Carpet
Clay Bricks	Concrete	Copper Wire
Corrugated Cardboard	Dimensional Lumber	Fly Ash
Food Scraps	Glass	Grass
HPDE	LDPE	Leaves
Magazines/ 3rd -Class Mail	Medium-Density Fiberboard	Mixed Metals
Mixed MSW	Mixed Organics	Mixed Paper (general)
Mixed Paper (primarily from offices)	Mixed Paper (primarily residential)	Mixed Plastics
Mixed Recyclables	Newspaper	Office Paper
Personal Computers	PET	Phonebooks
Steel Cans	Textbooks	Tires
Yard Trimmings		

Who Should Use WARM?

WARM was developed for solid waste managers (from state and local governments and other organizations) who want to calculate the GHG emissions associated with different waste management options. Emissions estimates provided by WARM are intended to support voluntary GHG measurement and reporting initiatives. These initiatives include waste management components of state and local climate change action plans, the Department of Energy's 1605(b) voluntary program for reporting GHG emissions, and other waste management projects for which an understanding of GHG emissions is desired.

Using WARM

Before using WARM, you first need to gather data on your baseline waste management practices and an alternative scenario. In order to effectively use the tool, users should know how many tons of waste was managed (or will be managed) for a given time period by material type and by waste management practice. The "mixed" material types are defined as the following:

- Mixed Plastics: HDPE 46%, LDPE 15%, PET 40%.
- Mixed Recyclables: Aluminum Cans 1.4%, Steel 3.4%, Glass 5.2%, HDPE 1.0%, LDPE 0.3%, PET 0.9%, Corrugated Cardboard 46.8%, Magazines/Third-class Mail 5.5%, Newspaper 23%, Office Paper 8.8%, Phonebooks 0.2%, Textbooks 0.4%, Dimensional Lumber 2.8%
- Mixed Organics: Food Scraps 48%, Yard Trimmings 52%.
- Mixed MSW- represents the entire municipal solid waste stream as disposed

Both models allow you to customize your results based on project-specific landfill gas recovery practices and transportation distances. Note that you may use default values if you are unsure of landfill gas recovery practices and/or transportation distances.

Web-based version:

- To use the web-based version of WARM, you will need Internet Explorer or Netscape versions 4 or higher.
- For the web-based WARM model to be able to calculate your GHG emissions you must enter the tons of each material type managed into the baseline and alternative management tables. The boxes in the baseline and alternative tables correspond to specific material types and management practices. Be sure to enter your data in the correct boxes.
- Answer the questions pertaining to landfill gas recovery and transportation distance by selecting the appropriate toggle buttons. If the requested data is not available, WARM will use the national average defaults.
- Select a format to display your results by selecting the corresponding toggle buttons for either MTCE, MTCO2E, or energy units (million BTU).
- To customize your report, enter your name, organization, and reporting period in the input cells.
- Once you have completed the tables and answered all of the questions on the inputs page, WARM will calculate the GHG emissions associated with the baseline and alternative waste management scenarios you specified. Click "Create Summary" to see your results.
- The summary sheet provides a concise report of GHG emissions from the baseline and alternative waste management scenarios, as well as an estimate of the net change in emissions.
- Once you have seen your results, you can return to the inputs page to run additional scenarios by selecting the button labeled "Exit Summary."
- Alternatively, you can view the emission factors used to estimate emissions for various materials and management practices; note that these emission factors will reflect national average default values for landfill gas recovery and transportation distances in the units you select. To access these emission factors, click the button labeled "View Emission Factors" from either the inputs page or the summary page.
- Please note that web-browser third-party tool bars (such as Google™) may attempt to "autofill" input cells and result in a yellow highlight. To prevent this please disable the autofill function of any third-party tool bars.

Microsoft Excel ® Version:

IMPORTANT	Because WARM employs macros, users must have Excel security set to medium (recommended) or low (not recommended). To change this setting, first launch Microsoft Excel before opening WARM. Once in Excel, go to the Tools menu, click on the Macro sub-menu, and then select "Security". The Security box will appear. Click on the "Security Level" tab and select medium. When set to high, macros are automatically disabled; when set to medium, Excel will give users the choice to enable macros; when set to low, macros are always enabled. When Excel security is set to medium, users are asked whether to enable macros upon opening the module. Click "Enable Macros" in order to activate macros, which will allow the tool to function properly.

- To use the Microsoft Excel© version of WARM, follow the directions on the Web site for downloading and installing Microsoft Excel© WARM. After successfully downloading the file, open the spreadsheet.
- Now, click on the "Analysis Inputs" tab at the bottom center of the screen to open the input sheet. Follow the instructions for Steps 1 and 2. This involves filling in the tables describing your baseline and proposed alternative waste management scenarios.
- Fill in the data requested in Steps 3-5. WARM will use the answers to these questions to customize its GHG estimates to reflect your waste management situation. For example,

you are asked for data on transportation distances and on your landfill gas recovery systems, if applicable. If the requested data is not available, WARM will use the national average defaults.

- Step 6 allows you to customize your report, with your name, organization, and project period.
- In Step 7, choose whether to have your results displayed in either MTCE or MTCO2E.
- If you are a participant in the Department of Energy's 1605(b) program, check the box in Step 8. This will display results phased over 30 years and by gas.
- To view the energy consumption impacts of your waste management scenarios, check the box in Step 9.
- Once you have completed Steps 1-9 on the "Analysis Inputs" sheet, WARM will calculate the GHG emissions attributable to the baseline and alternative waste management scenarios you have specified. Emissions calculations are presented on separate output sheets, as described below. From the "Analysis Inputs" sheet, click on a tab at the bottom of the screen for the results sheet you want to view first.
- The "Summary Report" sheet provides a concise report of GHG emissions from the baseline and alternative waste management scenarios, as well as an estimate of net emissions in the units selected.
- The "Analysis Results" sheet shows GHG emissions for each scenario in the units selected. You can compare the total impact of the baseline and alternative scenarios, or, if you want more detail, you can scroll down to view GHG emissions or energy results by material type and management practice.
- If you checked the "DOE 1605(b) User" box on the input sheet, the model provides the equivalent sheets displaying the results phased over 30 years, by gas, and by gas phased over 30 years.
- If you checked the "Energy Consumption" box on the input sheet, the model provides the equivalent sheets in units of energy consumption.

Assistance

If you need additional assistance with using WARM, please email Sara Hartwell (Hartwell.Sara@epamail.epa.gov).

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[1] MTCE and MTCO2E are units of measurement that express the heat-trapping effects of various greenhouse gas emissions in carbon and carbon dioxide equivalent, respectively. An international protocol has established carbon dioxide (CO2) as the reference gas.

SOUTH WILMINGTON SPECIAL AREA MANAGEMENT PLAN

NEW CASTLE COUNTY, DELAWARE

SUMMARY REPORT

September 2007

This project was funded, in part, through a grant from the Delaware Coastal Programs with funding from the Office of Ocean and Coastal Resources Management, National Oceanic and Atmospheric Administration under award number NA05NOS4191169

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EXECUTIVE SUMMARY

Rummel, Klepper & Kahl, LLP conducted a wetland survey from February to August 2007 on a 27 acre *Phragmites* wetland located between Walnut Street, A Street, S. Buttonwood Street, and Garasches Lane in South Wilmington, New Castle County, Delaware. Existing wetlands and their connection to the Christina River and other outside sources of water were identified and assessed for functionality for the Delaware Department of Natural Resources and Environmental Control (DNREC) as part of the South Wilmington Special Area Management Plan (SAMP) in Wilmington, Delaware.

A wetland assessment was performed using the Evaluation of Planned Wetlands (EPW) method, which allows for a pre- and post-restoration comparison. Hydrological conditions in the marsh were evaluated through surface water and groundwater HOBO data loggers, surface water YSI data sondes, tide gate inspections, and dye tests to evaluate the current and possible connections of the marsh to the Christina River and other water sources.

Wetland assessment results found that the existing wetland functions well in stabilizing sediments and improving water quality, but provides poor wildlife and fish habitat. Water quality function scores a little low due to the absence of fine sediment materials and the presence of water flow constrictions at pipes. The wildlife function scores low due to presence of contamination, no vegetative diversity, and little or no open water or habitat interspersion. Fish habitat receives a low score due to barriers to fish movement, few open water areas, encroaching urban development, and known sources of contamination. Wetland restoration efforts should focus on *Phragmites* eradication and control, increasing vegetation diversity, creating more open water areas, and increasing water connectivity.

To increase open water areas and water connectivity, the current ditches and culverts need to convey more water to the marsh. A tide gate inspection revealed that one gate needs to be repaired, while the other two need to be replaced. The current malfunctions led to present tidal influence in the ditch system. Dye tests and field observations found that it is possible that water from the Christina River can reach the main ditch from the north, though it is unknown whether there is a current tidal influence on the marsh. The connection to the Christina River to the west and the open-water area to the south is hindered by accumulation and debris in the culverts that connect the Norfolk Southern Railroad ditches to each other and to the wetland area. Preliminary water quality data found that there are no detrimental conditions in the water and that fully connecting the ditch to the river system will not change conditions much. No connections were found from the wetland to the South Wilmington community.

It is recommended that the tide gates be repaired or replaced, either in-kind or with an automated system. The automated system will allow for easier flood attenuation and control over water levels. Also, the installation of another tide gate near the wetland/community line will be beneficial for wetland flushing and to attenuate current or potential flooding in the South Wilmington community. Before design can begin, the following needs should be addressed: defining the limits of the wetland, defining and discussing the extent of contamination and disposal issues, conducting an H&H study, and assessing pipe hindrances.

1.0 INTRODUCTION

The South Wilmington Special Area Management Plan (SAMP) is a cooperative effort of community members, business leaders, not-for-profit organizations, and agency staff to create a comprehensive plan for the revitalization of South Wilmington. A major recommendation of the SAMP Neighborhood Plan and SAMP Drainage Study is the restoration of the South Wilmington Wetland. Investigations into the feasibility of restoring the marsh are currently being led by the DNREC, Division of Soil and Water Conservation, Delaware Coastal Programs and the City of Wilmington. The wetland is located within South Wilmington, between Walnut Street, A Street, S. Buttonwood Street, and Garasches Lane. The objective of the project is to rehabilitate degraded wetland habitat and create a multi-functional natural area and open space that provides wetland habitat, recreational opportunities, and storm-water management for the adjacent areas of South Wilmington.

A functional assessment of the existing wetland is one of the initial project tasks undertaken by DNREC towards the restoration of the South Wilmington Wetland. The wetland assessment was performed using the Evaluation of Planned Wetlands (EPW) method, which was chosen because it allows comparison of weighted functional values between an existing wetland and the planned, restored wetland. This will provide useful guidance in the design process to maximize the wetland functions that will be provided by the planned wetland.

Field investigations were also conducted to assess the current hydrologic connection of the wetland to outside water bodies, such as the Christina River. HOBO depth data loggers, YSI data sondes, tide gate inspections, and dye tests were employed to analyze both current water conditions and flow patterns in the vicinity of the marsh. This will supply information on current connections throughout the marsh, as well as the feasibility of future connections.

2.0 BACKGROUND AND EXISTING CONDITIONS

Rummel, Klepper & Kahl, LLP conducted a wetland and hydrological assessment in April and May 2007 on the South Wilmington wetland, located between Walnut Street, A Street, S. Buttonwood Street, and Garasches Lane in Wilmington, New Castle County, Delaware (Figure 1). The study area consists of approximately 27 acres of wetland and uplands that are bounded by developed land. The development to the north, south, and west is predominately industrial or commercial, while the residential community of Southbridge is located to the east.

The study area encompasses several natural communities, although a dense *Phragmites* marsh covers the majority of the area. Open-water ditches, small forested areas, shrub thickets, and an area of maintained lawn within a radio tower site also occur within the study boundaries. Numerous debris piles and slag heaps, the byproduct of ore-smelting operations, are located around the perimeter of the existing wetland (Figure 2).

Research was conducted on existing environmental conditions within the study area prior to field investigations. Documents reviewed included the USGS 7.5 minute topographic map for the Wilmington South Quadrangle, the soil map from the U.S. Natural Resource Conservation Service Soil Map, the U.S. Fish and Wildlife Service's (USFWS) National Wetland Inventory (NWI) map, and the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) panel number 10003C0160J for New Castle County, Delaware, located in Appendix A.

2.1 Topography and Geology

The study area is mostly low-lying, flat ground surrounded by industrial development. Elevations range from approximately -3 feet to 12 feet above mean sea level, with the higher elevations located on debris piles or fill areas that encircle the existing wetland (Figure 2).

The study area lies within the Delmarva Coastal Plain physiographic province. The Coastal Plain is typified by sedimentary deposits that dip gently and increase in thickness toward the southeast. The dominant geologic formation within the center of the study area is Holocene marsh deposits, which are composed of structureless to finely laminated, black to dark-gray, organic-rich silty clay to clayey silt with discontinuous beds of peat and rare shells. Fragments of marsh grasses, such as *Spartina*, are present, as are clayey silt deposits originating from estuarine channel formation and migration. The Scotts Corners Formation surrounds the Holocene marsh deposits and is located on the edges of the study area. This Formation is a heterogeneous unit of light-gray to brown to light yellowish brown, coarse to fine sand, gravelly sand and pebble gravel with discontinuous beds of organic-rich clayey silt, clayey silt, and pebble gravel. It is commonly capped by one to two feet of silt to fine sandy silt. Sand grains present within the formation are predominantly quartz, with minor amounts of feldspar and muscovite (Ramsey 2005). Extensive areas of debris, fill, and industrial slag deposits overlay the naturally occurring geologic formations in many locations, especially around the perimeter of the existing marsh.

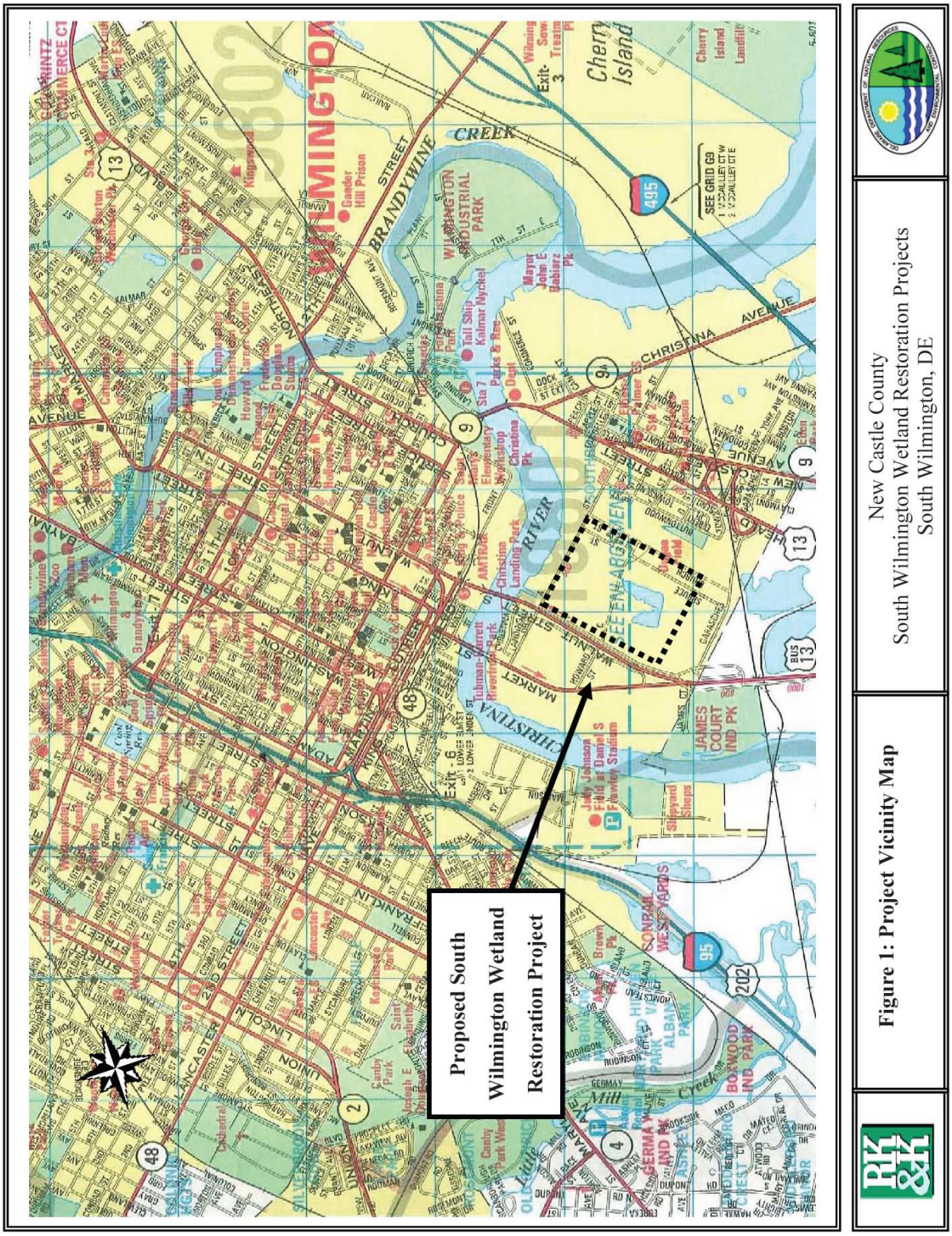
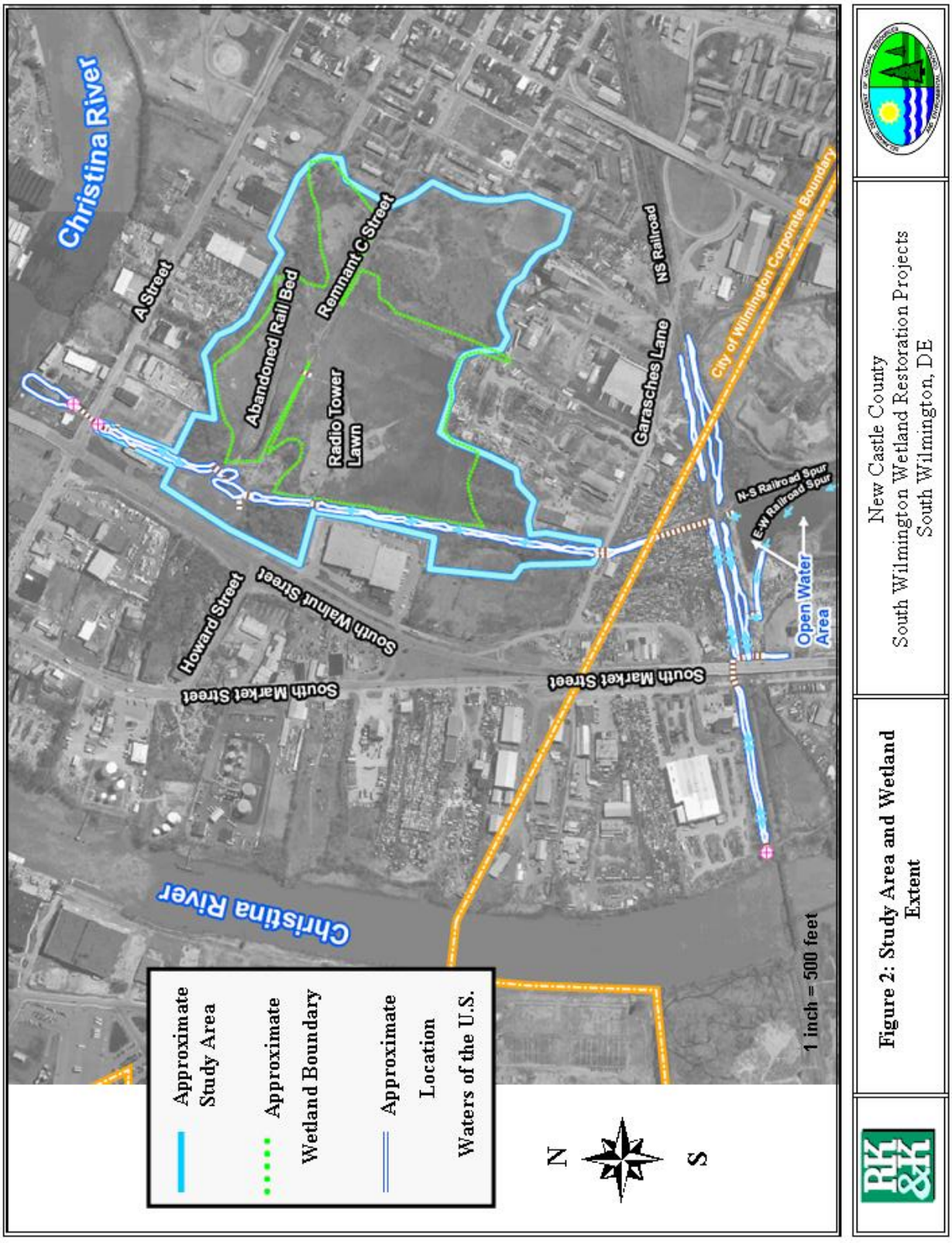


Figure 1: Project Vicinity Map

New Castle County
South Wilmington Wetland Restoration Projects
South Wilmington, DE


Christina River
A Street
Abandoned Rail Bed
Remnant C Street
Radio Tower Lawn
NS Railroad
Garasches Lane
City of Wilmington Corporate Boundary
N-S Railroad Spur
E-W Railroad Spur
Open Water Area
Howard Street
South Walnut Street
South Market Street
South Market Street
Christina River
Approximate Study Area
Approximate Wetland Boundary
Approximate Location Waters of the U.S.
N
S
1 inch = 500 feet
RK&K
Figure 2: Study Area and Wetland Extent
New Castle County
South Wilmington Wetland Restoration Projects
South Wilmington, DE

2.2 Soils

The South Wilmington area is located within the Delmarva Coastal Plain Province, which is dominated by sands, gravels, and clays. Like many urban areas, most of the original soils in the South Wilmington area have been extensively disturbed, making classification of the soils difficult. Old fire insurance maps and aerial photographs show that the area was undeveloped open space with a rail line on C Street until 1901. In 1937, parts of the marsh were cultivated for hay or other crops and there is evidence of roads and dirt trails. It was not until 1954 that fill activities were evident (Hendershot and Asreen 2005a and 2005b). A small portion of the South Wilmington area remained undisturbed wetland, the center of the South Wilmington Wetland, which is an area of silty clays. The four soil extents that occur within the study area are shown in Appendix A, and descriptions for each are listed in the table below.

TABLE 1: SOILS WITHIN SOUTH WILMINGTON WETLAND
(NRCS and South Wilmington SAMP Ecological Characterization Workgroup 2006)

SOIL SERIES (MAP CODE)	DESCRIPTION
Made Land (Ma)	Areas that have been filled with soil material, trash, or both that have been so altered or disturbed that classifying the soil is no longer feasible. Original soil may have been removed completely or filled with 18" or more of other material. Available water capacity is very low and shrink swell potential is low. The suitability of a given area for any use must be determined by an onsite examination.
Othello silt loam (Ot)	The Othello series consists of very deep, poorly drained, moderately slowly permeable soils on upland interfluves, lowlands, marine terraces, and depressions. Slope ranges from 0 to 5 percent. Shrink-swell is low and water capacity is high. Corrosion of untreated pipe is high. This soil is hydric.
Othello-Fallsington-Urban Land Complex (Ou)	Consists of poorly drained, level Othello or Fallsington soils that have been used for residential, commercial, or industrial development. Shrink-swell is low and water capacity is high. Both Othello and Fallsington are hydric soils. Much of this complex has been covered by as much as 18" of fill, which has a low water capacity and shrink-swell potential.
Tidal Marsh (Tm)	Very poorly- drained soils that are regularly flooded (usually readily apparent to most people in the field) by tidal waters and also have an odor from hydrogen sulfide. Available water capacity and shrink-swell potential are moderate. All development is severely limited and discouraged.

2.3 Soil Contamination

Historical heavy and light industrial and commercial activities in South Wilmington have resulted in soil contamination. Soils sampled near South Wilmington as part of an environmental assessment by the DNREC Superfund Branch prior to 1996 showed industrial sites containing elevated concentrations of arsenic, lead, chromium, and other inorganic materials. Additionally, samples taken from South Wilmington scrap salvage yards contained PCBs above industrial and residential risk levels (Breslin 1996 in South Wilmington SAMP Ecological Characterization Workgroup 2006). A list of known and suspected contaminants at nearby brownfield sites is supplied in Appendix A. Known contaminants are those that have been tested and confirmed on site, while suspected contaminants are those that have not been tested, but have been historically found on site. The location of the properties and lot numbers are indicated in Appendix A. In 2005, sediment samples taken in the marsh as part of a DNREC Site Investigation indicate that

the sampling sites have been impacted by metals, such as arsenic, mercury, lead, copper, and zinc, semi-volatile organic carbons (SVOCs), such as benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene, dibenz(a,h)anthracene, Est PAH TICS, and Est Total TICS, and, to a limited extent, PCBs, such as arochlor-1248 (Hendershot and Asreen 2005a and 2005b).

2.4 Hydrology

The South Wilmington Wetland is approximately 1,300 feet south the Christina River and 2.5 miles west of the Delaware River. The area is located within the Brandywine Christina Watershed (NWDB 02040205), which is part of the Lower Delaware Sub-Basin (02-04-02).

According to the USGS Topo Map, there is a ditch along the western side of the proposed restoration project that appears to connect to the Christina River just east of the Walnut Street Bridge, regulated by a tide gates located on both sides of A Street. This ditch appears to run under Garasches Lane and connect to open-water ponds south of the railroad tracks shown on Figure 1. This area connects to the Christina River via ditches on the northern side of the Norfolk Southern (NS) Railroad, regulated by another tide gate. The USGS Quad and the ADC vicinity map show open water in the southeastern portion of the existing wetland. This open water is not visible on the aerial photography (Figure 2).

According to the New Castle County National Flood Insurance Rate Maps, most of the site is located within the 100 year flood zone (Zones A and AE), with small pockets in the 500 to 500+ year flood zone (Shaded Zone X and Zone X, Appendix A).

The National Wetland Inventory Map (NWI) is a digital resource that gives a general delineation of wetlands based on the analysis of high altitude imagery; wetlands are identified based on vegetation, visible hydrology, and geography. This is a general resource that can be incorrect and thus does not replace actual field reconnaissance efforts. The mapping resource identifies four wetland types within the study area (Appendix A). The southernmost large wetland is classified as a palustrine, emergent, persistent, semi permanently flooded (PEM1F) wetland. The smaller, southern wetland is a palustrine, unconsolidated bottom, permanently flooded, diked/impounded (PUBHh) wetland. The northern wetland is classified as a combination palustrine, emergent, persistent (PEM1) and scrub-shrub, broad-leaved deciduous, seasonally flooded/saturated (SS1E) wetland. The smaller, eastern wetland is a palustrine, scrub-shrub, broad-leaved deciduous, seasonally flooded (PSS1C) wetland.

The *State of Delaware 2006 Delaware Watershed Assessment Report (305(b)) and Determination for the Clean Water Act Section 303(d) List of Waters Needing TMDLs* (Total Maximum Daily Loads) identifies the pollutants/stressors in the Middle Christina River segment, which runs along the South Wilmington study area until the Brandywine River, to include: nutrients (nitrogen and phosphorus), polychlorinated biphenyls (PCBs), bacteria, and dieldrin (a pesticide). The study area is adjacent to the tidal Christina River watershed, which was characterized by the Water Resource Agency in 1998 as having extremely high total suspended sediment (TSS) loads, amounting to 928 lb/ac/yr in 1998, the second highest TSS load in the entire Christina Basin. The Christina River watershed also exhibited high levels of bacteria, iron, phosphorus, and polychlorinated biphenyls (PCBs) (Water Resources Agency 1998 in DNREC

2007). There is a fish consumption advisory in the tidal Christina River, where consumption of all finfish is prohibited due to PCB and dieldrin contamination.

Surface water samples taken as part of an environmental assessment by the DNREC Superfund Branch showed levels of aluminum, iron, lead, PCBs, and metals, including arsenic, chromium, cyanide, and mercury, that exceeded risk-based concentrations (Breslin 1996 in South Wilmington SAMP Ecological Characterization Workgroup 2006). In 2005, surface water samples taken in the marsh south of old C Street as part of a DNREC Site Investigation indicate that the sampling sites have been impacted by metals, volatile organic carbons (VOCs), semi-volatile organic carbons (SVOCs) and pesticides (Hendershot and Asreen 2005a and 2005b).

Ground water samples, taken as part of an environmental assessment by the DNREC Superfund Branch, showed levels of arsenic, iron, and manganese that exceeded risk-based concentrations (Breslin 1996 in South Wilmington SAMP Ecological Characterization Workgroup 2006). In 2005, shallow ground water samples taken in the marsh as part of a DNREC Site Investigation indicate that the sampling sites have been impacted by VOCs, pesticides, and metals, especially arsenic, iron, and manganese (Hendershot and Asreen 2005a and 2005b).

2.5 Ecology

Little information is currently available on species or habitat utilization within the South Wilmington wetland. The Russell W. Peterson Urban Wildlife Refuge is a restored, tidal, freshwater marsh located west of the study area, across the Christina River (Appendix A). Zoological and botanical surveys completed in 1999 at this restored tidal wetland can provide a general idea of the species that might utilize restored wetland habitat at the South Wilmington Wetland Restoration Project.

The botanical survey conducted by the Delaware Natural Heritage Program found no state or federally listed rare and/or endangered plant species in the Petersen Wildlife Refuge, however, eight exotics plants were observed, including purple loosestrife *Lythrum salicaria*, mile-a-minute *Polygonum perfoliatum*, common reed grass *Phragmites australis* and the reed canary grass *Phalaris arundinacea* (South Wilmington SAMP Ecological Characterization Workgroup 2006). These species are all common invasive plants and their presence in mitigation and restoration wetlands projects must be controlled. A complete list of species within the Russell W. Peterson Urban Wildlife Refuge is located in Appendix A.

3.0 WETLAND ASSESSMENT

RK&K conducted a wetland delineation on the northwestern corner of the study area in October 2006 and a wetland assessment of the entire study area in early April 2007. On April 24, 2007, fire burned much of the standing, dead biomass of *Phragmites* in the South Wilmington Wetland. RK&K investigated the extent of the burn damage on May 2, 2007. A summary of field observations and the results of the assessments follow.

3.1 Methods

Natural resource scientists visited the project area and walked throughout the marsh and the surrounding uplands. Notes on topography, existing vegetation, hydrology, and wildlife were collected to understand the existing wetland and its extent. This overview of the entire wetland system was required to perform the wetland assessment, which was conducted using the EPW method (Bartoldus et. al 1994). Potential surface water connections were located and dye tests were employed to trace potential flow pathways. The site was revisited after the fire and additional observations were made, especially on site topography and hydrology, which were more apparent without the dense stand of dead *Phragmites*.

The EPW approach was utilized to evaluate the condition of the South Wilmington Wetland. EPW is a rapid and comprehensive method, designed to compare existing habitats or wetlands to a planned wetland. The method assesses a comprehensive list of wetland functions that are weighted to allow comparisons between an existing wetland assessment area (WAA) and a planned wetland design.

The weighted functional value is called the Functional Capacity Index (FCI). It is a value from 0.0 to 1.0, with a score of 1.0 indicating that the wetland performs the assessed function at optimal capacity. EPW assesses the following functions: shoreline bank erosion control (SBEC), sediment stabilization (SS), water quality (WQ), wildlife habitat (WL), fish habitat (tidal (FT), non-tidal (FS), and non-tidal lakes and ponds (FP)), and uniqueness/heritage (UH). Each FCI can also be weighted by the size of the assessed wetland area to provide Functional Capacity Units (FCUs).

Specific elements comprise models used to calculate each FCI. Each model is composed of 7 to 21 elements, which are based on concepts derived from scientific literature relevant to the assessed wetland function. Each element of the model is given a score based on presence/absence or best professional judgment. Many of the elements are specific such that they can act as design points for creating a planned wetland that will optimize the FCI.

3.2 Field Observations

The entire study area was investigated to understand the overall land cover and conditions, and to establish the extent of existing wetland for the assessment. The study boundary encompasses several natural communities, but most of the area is covered by a large wetland dominated by dense *Phragmites australis* (Figure 2). The existing wetland also includes a small fringe of forested wetland in its northeast corner. There is an open-water ditch along the west side of the study area, young forests and shrub thickets along the perimeter of the wetland, an area of maintained lawn inside the wetland, and several industrial lots. There are numerous large, old, debris and rubble piles located around the perimeter of the wetland and a few small piles within the *Phragmites* marsh. After the marsh fire on April 24, 2007, the area was revisited to investigate damage to existing habitats and to observe what new features may have been exposed by the fire. All photos are contained in Appendix B.

3.2.1 General Landscape

The study area is generally flat, with a center dominated by a dense *Phragmites* marsh. There is a large area of maintained lawn in the center of the marsh at the site of a radio tower (Figure 2). *Phragmites* extends to the east and south of this lawn, ending at the wetland-upland boundary. The wetland-upland boundary is formed by a steep, concrete-lined slope along the southern edge of the marsh, while the eastern boundary is a more gradual slope up and out of the wetland. The western edge of the wetland is formed by a low berm separating the marsh from an open-water ditch. Remnant C Street, which appears to be maintained, cuts across the marsh and physically separates the northern third of the wetland from the southern two-thirds. An abandoned, raised, railroad bed is immediately north of old C Street. The *Phragmites* marsh extends north of the rail bed until it meets an abrupt upland slope.

3.2.2 Existing Vegetation

The existing wetland is predominately a dense, single-species stand of *Phragmites* (Photos B1-B2) with a small fringe of forested wetland in the northeast corner (Photo B3). This forested wetland is dominated by mature green ash (*Fraxinus pennsylvanica*), red maple (*Acer rubrum*), and silver maple (*Acer saccharinum).* There are also a few scattered, small trees and shrubs on small mounds within the *Phragmites* marsh and on the uplands around the wetland. The young, scrubby, shrub and tree uplands along the northern, eastern, and southern side of the wetland are dominated by species such as shrub honeysuckle (*Lonicera sp*.), box elder (*Acer negundo*), red maple (*Acer rubrum*), red mulberry (*Morus rubra*), and black locust (*Robinea pseudoacacia*) (Photo B4). There are also small, scattered pin oak (*Quercus palustris*), green ash (*Fraxinus pensylvanica*), and sycamore (*Platanus occidentalis*) within these forests. The upland berm that separated the *Phragmites* marsh from the open-water ditch along the west side of the study area is covered in dense rose (*Rosa multiflora*) and blackberry (*Rubus sp*.) shrubs and scattered small trees (Photos B5-B6). This berm may be mowed to maintain access to the utility poles and lines that run along it.

3.2.3 Existing Wildlife Habitat

The dense *Phragmites* appeared to provide poor wildlife habitat (Photo B7), and most wildlife was observed on the edges of the marsh or in the surrounding uplands. Small top minnows and

turtles were observed in the open-water ditches, but no aquatic organisms were seen within the *Phragmites* marsh. Sparrows, red-wing blackbirds, catbirds, and several other song bird species were heard along the perimeter of the marsh. No traces of common mammals, such as deer bedding, woodchuck burrows, or fox tracks, were observed.

3.2.4 Wetland Disturbances

Evidence of human disturbance was common along the perimeter and within the edges of the wetland. The slope along the entire southern edge of the wetland is composed of concrete rubble with additional rubble, construction debris, and trash extending back into the forest. The southeastern corner of the wetland and the adjacent uplands contain slag piles and fill materials (Photos B8-B14). Debris has been dumped along the northern edge of the wetland, and the elevated ground in the northwestern corner of the study area is largely composed of fill materials containing chunks of brick, concrete, and slag. Debris, fill materials, and slag along the perimeter and in the wetland appear to be relatively old.

3.2.5 Observations Made After the Wetland Fire

RK&K scientists visited the South Wilmington Wetland Restoration Project area on May 2, 2007, approximately a week after the marsh burned. Most of the dead, standing biomass of *Phragmites* was eliminated down to the soil surface or water line. Some low trees and shrubs on the uplands along the eastern side of the wetland were also burned (Photo B15). New shoots and rhizomes of *Phragmite*s appeared to be impacted minimally by the fire, and a new crop is likely to dominate the wetland within a few weeks (Photo B16). The removal of the dead, standing biomass provided an unencumbered view of the surface and revealed additional slag and debris piles, the railroad bed north of old C Street, old DNREC monitoring wells, and the slope along the western side of the wetland (Photos B9-B14, B17, B18). Several discontinuous berms, most likely spoil piles from previous mosquito ditching activities, were visible within the southern portion marsh, as were two rows of slag debris (Photos B19-B20). The loss of standing biomass also revealed the full extent of standing water within the *Phragmites* marsh and showed that there are no large drainages through the center of the marsh.

3.2.6 Observations on Functions Performed by the Existing Wetland

A number of conclusions regarding wetland functions can be drawn from the observations collected during field investigations. The flat topography and dense, emergent vegetation of the *Phragmites* marsh should provide excellent sediment stabilization. The lack of open water and the large amount of concrete and slag rubble at the edge of the wetland suggests that the "shoreline" is very stable. The dense vegetation and slow-flowing or stagnant surface water suggests that the existing wetland also provides excellent filtration and water quality benefits. Unfortunately, the large amount of trash and debris, potentially hazardous slag, and other, unknown contaminants may result in a net release of toxic or hazardous materials to the surface water. The dense *Phragmites* marsh provides limited habitat for both terrestrial and aquatic organisms. The vast expanse of dense vegetation with no open or deepwater areas provides poor habitat for fish and aquatic vertebrates. While wetland birds will utilize the edge of the marsh for nesting and foraging, much of the marsh interior provides little or no habitat. The existing wetland vegetation has little species or structural diversity, therefore providing minimal wildlife habitat.

3.3 EPW Assessment Results and Discussion

Based on field observations, it was determined that the South Wilmington Wetland would be assessed as a single unit, or wetland assessment area (WAA). The existing wetland is a uniform community of *Phragmites* with little variability in the vegetation community, topography, or hydrology. The small area of forested wetland fringe in the northeastern corner of the study area is too small to warrant a separate assessment or to weigh heavily in the assessment results. It was assumed that the wetland is not subject to tidal hydrology.

The EPW method allows comparison of the FCI for each assessed function between the WAA (the existing wetland) and the planned, restored wetland. The comparison of the FCIs and the elements of the model from which they are calculated provides useful guidance in the design process to maximize the wetland functions provided by the planned wetland. The assessment data sheets in Appendix B do not have assigned FCI values for the planned wetland, but the desired goal is to optimize all wetland functions to the greatest extent possible in any wetland restoration design.

The South Wilmington wetland scored high for functions relating to physical and chemical processes but scored poorly for wildlife and fish habitat. Table 2 summarizes the functional capacity of the existing wetland. These results suggest the wetland has low biological value and that restoration goals should focus on significant improvements in wildlife and fish habitat. The following discussions provide a detailed analysis of the scoring elements for each function.

TABLE 2: SOUTH WILMINGTON WETLAND ASSESSMENT AREA - EPW RESULTS

Assessed Function	Calculated FCI*
Shoreline Bank Erosion Control	1.0
Sediment Stabilization	1.0
Water Quality	0.8625
Wildlife	0.135625
Fish (nontidal, stream/pond)	0.305/0.56875
Uniqueness/Heritage	NA

*1.0 = optimal function

The wetland assessment area scored optimally for shoreline bank erosion control (SBEC) and sediment stabilization (SS). Examination of the model used to calculate SBEC shows that the dense vegetation and shallow water in the wetland both limit physical disturbance that causes erosion and hold the sediments or substrate in place with vegetative biomass. Examination of the SS model shows that the dense vegetation, infrequent disturbance, and stable slopes around the wetland optimize the stability of the sediments and substrate.

The functional capacity score for water quality (WQ) was relatively high, at 0.8625. The assessment suggests that the coarse fill materials and sandy soils that compose most of the substrate in the wetland reduces the opportunity for water-substrate contact, nutrient retention, or chemical transformation because of rapid movement and high conductivity of water through

these coarse materials (Bartoldus et al. 1994). The model suggests that the addition of fine mineral soils in the planned wetland would optimize the water quality function of the wetland. In addition, much of the surface flow in the wetland occurs as sheet flow, but constriction at pipes under remnant C Street and into the open-water ditch reduces sheet flow and inhibits the surface water interaction with vegetation and soils. Sheet flow has a greater potential to improve water quality due to increased frictional resistance which increases sedimentation, and increased surface area which increases the water interaction with soil/vegetation (Bartoldus et al. 1994). The replacement of existing pipes with wider, vegetated outlets may provide improvement in water quality.

The wildlife function (WL) of the existing wetland is poor. This FCI scores low due to several factors: there is presence of contamination; there is no diversity in the vegetation structure or species composition; and there is little or no open water or habitat interspersion. The greater the diversity of plant species and vegetative structure, the more likely an area is to harbor a diverse wildlife contingent. Monocultural stands, especially of *Phragmites*, are considered to have a very low diversity of wildlife and thus score low (Bartoldus et al. 1994). Minimal open water reduces the abundance of water-dependent birds and amphibious vertebrates such as turtles and muskrats. Fifty percent cover has been found to support a high diversity and abundance of water dependent birds, with either extreme cover supporting very little (Bartoldus et al. 1994). This poor functional index suggests that a diverse vegetation community, containing herbaceous and wood vegetation interspersed with open water and upland islands, would maximize wildlife habitat in a planned wetland.

Fish habitat (FP) also scores low due to multiple elements in the FCI model. The two fish FCIs are looked at together for similar detrimental factors. Tide gates, culverts, pipes, and debris piles act as barriers to fish movement. Fish may not occupy an area because an obstacle imposes an absolute physical or behavioral barrier (Bartoldus et al. 1994), and while top minnows were observed in the open-water ditch along the west side of the wetland, none were seen within the marsh because the only surface water connection appeared to be a single 12-inch pipe. Another detriment is the lack of habitat due to relatively few open-water areas and extensive local development. All these factors limit the diversity and abundance of fish that can utilize the area and reduce effective habitat size. High nutrient, sediment, or contaminant sources limit the sites potential as fish habitat as well. Pollutants can cause high fish mortality directly or indirectly by contaminating or reducing the abundance of food sources concentrations- the higher the contamination, the less likely fish survival (Bartoldus et al. 1994). The potential for fish habitat at the existing marsh is limited because there are barriers to migration into the wetland, there is very limited open-water habitat, and habitat that is present may be contaminated. The assessment suggests that better connectivity to adjacent open water, the creation of more open and deep-water areas within the marsh, and the removal of contaminants would greatly improve fish habitat in a planned wetland.

4.0 WETLAND DELINEATION

RK&K contracted with the City of Wilmington to conduct a wetland delineation and jurisdictional determination for the South Wilmington Wetland Restoration Project. Delineation was performed September 19 and 20, 2007. Wetland and water flags will be surveyed by October 1, 2007. The wetland delineation report is forthcoming.

5.0 HYDROLOGIC ASSESSMENT

RK&K conducted a hydrologic assessment of the entire wetland and surrounding area April 4, 2007. This included dye tests and a visual inspection of culverts and flow direction. In addition, underwater inspection of the tide gates on the west and north of the wetland occurred May 4, 2007 and additional observations were collected on May 4, 2007. HOBO depth data loggers and YSI data sondes were also deployed to collect groundwater and surface water depth data, as well as surface water conditions. A summary of field observations and the results of the data collection follow.

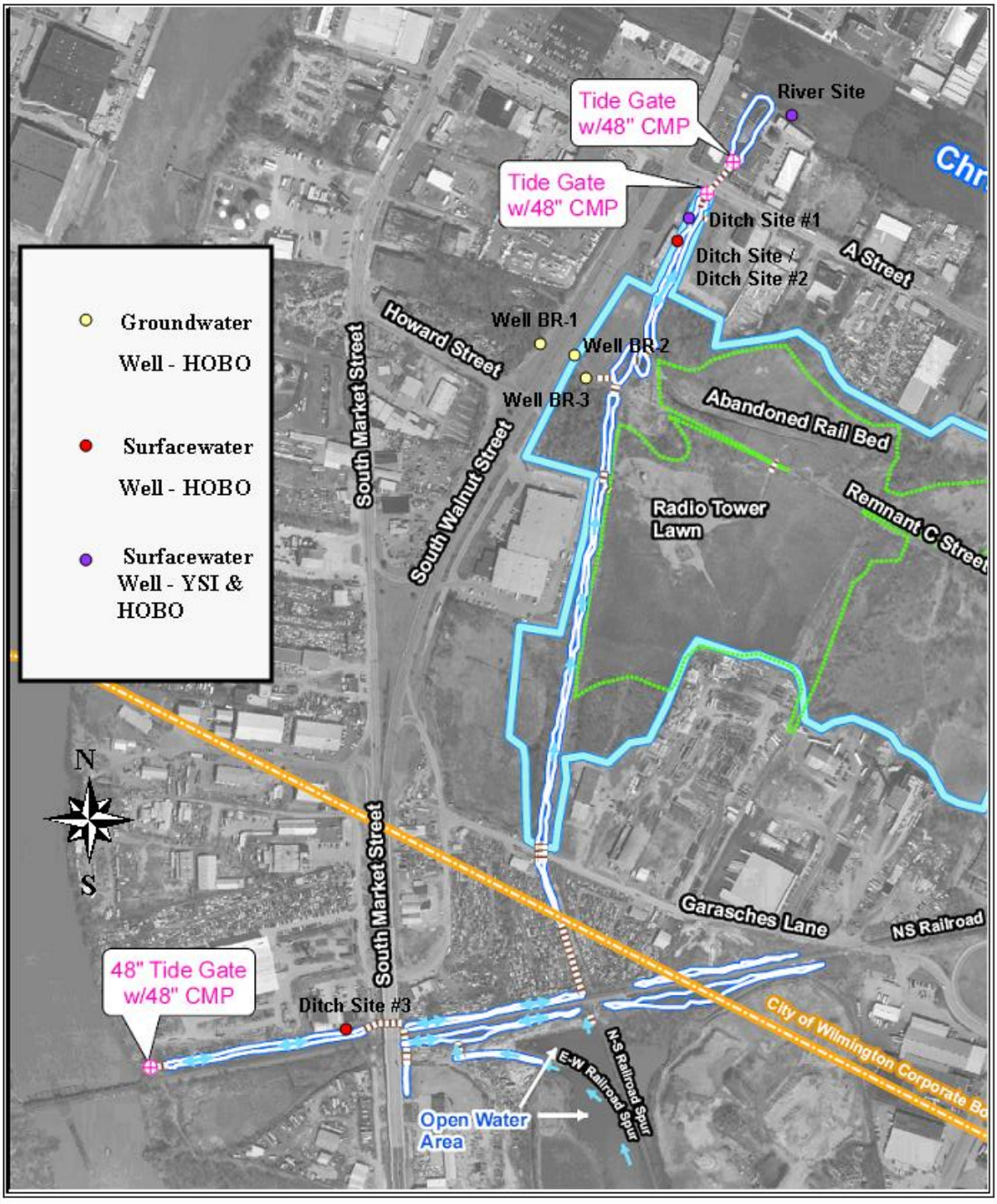
5.1 Methods

Water resource and natural resource scientists visited the project area and walked throughout the marsh and the surrounding ditches. Photos from the area are located in Appendix C and D. Notes on culvert size, type, and condition were taken to assess hydrologic connectivity. Dye tests were conducted April 4, 2007 to assess flow direction and relative speed south and north of the marsh. Complete results from the dye test are located in Appendix D. Subsequent investigations assessed tidal effects on flow. Culvert locations can be seen on Figure 3.

Three tide gates were inspected: one at the northeast corner of A Street and Walnut Street on the Christina River, one at the southeast corner of A Street and Walnut Street, and one west of South Market Street, along the Norfolk Southern Railroad (Figure 3). Inspection work was conducted by a 4-man dive crew experienced in underwater inspection and included a registered Professional Engineer for direction and supervision.

Groundwater and surface water data was also obtained for the site. Three groundwater wells were installed near the intersection of Howard Street and South Walnut Street (Figure 3). One is near the northwest corner of the intersection parallel to remnant C Street, while the other two are located on the north and south sides of remnant C Street, west of the ditch. Data was collected from February to September. Four HOBO depth loggers were installed in the ditch system leading to the South Wilmington wetland to measure surface water (Figure 3). One is located in the Christina River, two are located in the ditch south of A Street, and one HOBO is located in a ditch west of Market Street and north of the Norfolk Southern Railroad. Data collection occurred from May to September except in the ditch near Norfolk Southern Railroad, which only collected data from August to September. All depth logger data was corrected to NAVD88.

Two YSI data sondes were installed at the same time and locations as the HOBO surface water depth loggers (Figure 3) to monitor the water condition. One is located in the Christina River and the other is in the ditch south of A Street, parallel to the Shell gas station. Data recorded includes temperature, specific conductivity, salinity, dissolved oxygen (percent and mg/l), pH, and turbidity.



RK&K	**Figure 3: Tide Gate and Well Locations**	New Castle County South Wilmington Wetland Restoration Project South Wilmington, DE	

5.2 Tide Gate Inspection

An underwater inspection of the tide gates on May 4, 2007 confirmed that the tides gates are malfunctioning and not operating as designed (see Appendix C for the Tide Gate Inspection Report and Repair Recommendations and Cost Estimates for Tide Gates).

The tide gate at the northeast corner of A Street and Walnut Street on the Christina River is approximately 6 feet wide by 4 feet high overall. The interior and exterior faces of the steel gate have light to moderate corrosion and the concrete headwall has moderate scale throughout and a 1-foot by 1-foot by 8-inch deep spall at the top northeast corner. The tide gate does not close properly at high tide due to anaerobic bacteria corrosion nodules that have roughened the sealing surface and to improper adjustment of the alignment hardware at the upper hinges. It is recommended that the seals be cleaned, the hinges adjusted, debris cleared, and grease fittings replaced. This is estimated to cost $6,600. There should also be annual maintenance of inspecting, clearing, exercising, and greasing which will cost $3,000.

The circular steel tide gate at the southeast corner of A Street and Walnut Street in an access hatch has an approximate 4-foot diameter sealing surface. The interior and exterior faces of the steel gate have light to moderate corrosion and the wall surfaces of the concrete hatch have moderate scale throughout. The steel gate does not seal tightly during high tide due to anaerobic bacteria corrosion nodules that have roughened the sealing surface and to improper adjustment of the alignment hardware at the upper hinges. It is recommended that the tide gate is replaced and the headwall receive minor preparation or replacement. There are two replacement options: one is a cast iron flip valve and the other is a flexible flap valve, which is the preferred alternative by M&N Diving and Engineering Services. The first option costs $34,300 and the second option costs $34,200. There should also be annual maintenance of inspecting, clearing, exercising, and greasing which will cost $3,000.

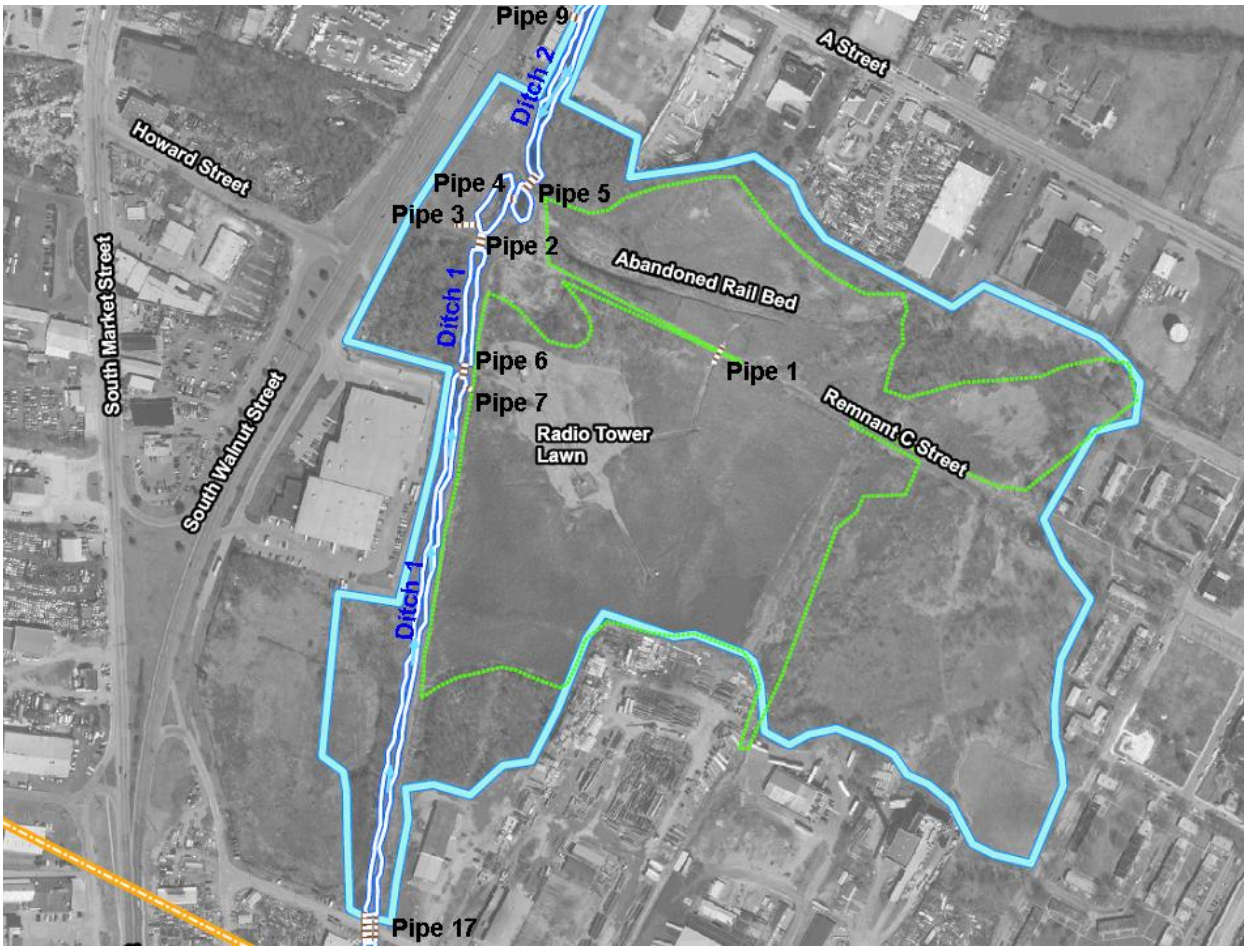
The circular aluminum tide gate west of Market Street along the railroad tracks on the Christina River has an approximate 4-foot diameter sealing surface. The aluminum tide gate has little to no corrosion. The gate can only open 2 feet due to a large amount of debris at the outlet and cannot close fully due to large rocks located in the sleeve. There is also a broken 2-inch mounting angle at the north hinge. It is recommended that the tide gate is replaced and the headwall receive minor preparation or replacement. There are two replacement options: an aluminum flap valve and the other is a flexible flap valve, which is the preferred alternative by M&N Diving and Engineering Services. The first option costs $21,500 and the second option costs $27,200. There should also be annual maintenance of inspecting and clearing which will cost $1,000.

Another option not set forth in the Tide Gate Repair Recommendations is the replacement of the tide gates with an automated system. This would allow for easier regulation of surface water levels and would allow for better water level control during flood events. This is an important consideration given that the South Wilmington communities currently have flooding problems. The option of adding another tide gate north of A Street between the wetland and the community should also be entertained to mitigate flood flows and help in the flushing of the northern part of the wetland.

5.3 Dye Test Results and Field Observations

5.3.1 Hydrology Within the Marsh

Several inches of standing water were observed throughout the *Phragmites* marsh, with a few areas in the southern portion of the wetland with greater than six inches of surface water (D1-D2). The surface water within the wetland did not appear to fluctuate regularly, which suggests that it is not tidally influenced. No standing water was observed on the radio tower lawn, on remnant C Street, or on the raised, abandoned rail bed, all of which appear to be slightly elevated when compared to the surrounding wetland (Photo D3-D5). The only elevated area that creates a hydrological divide in the marsh is the abandoned rail bed. Overall, field observations suggest that surface water within the wetland is derived from runoff and shallow groundwater discharge. However, five culverts were found that could affect flow patterns within the marsh.



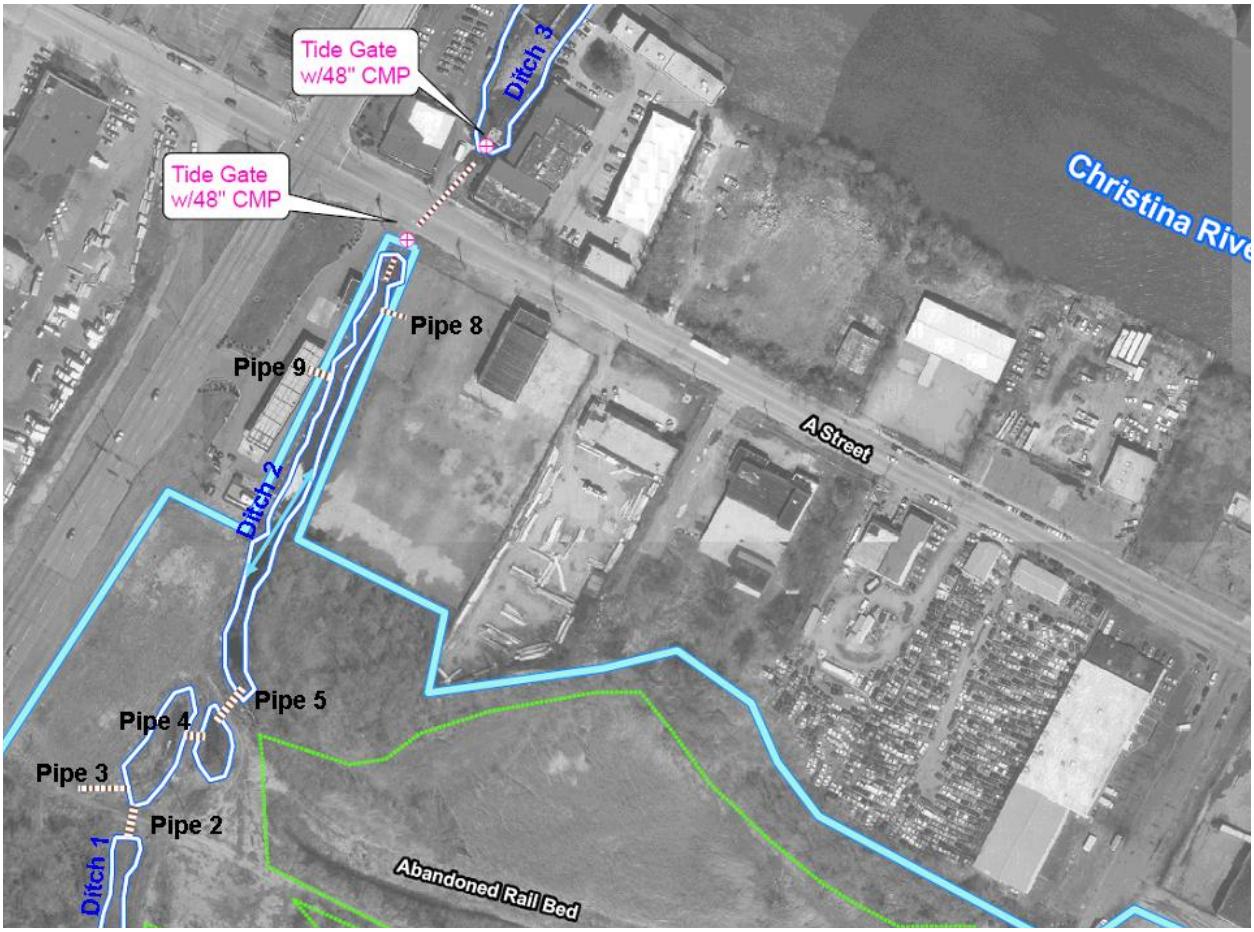
Two drainage pipes are located under remnant C Street, allowing flow north and south. One 12-inch corrugated metal pipe (CMP) is located north of the eastern extent of the radio tower (Photo D6; Pipe 1). The pipe seems to be covered with debris, but evidence of flow was seen. The other pipe is a 48-inch CMP which connects the ditch on the western side of the marsh (Ditch 1) to a ponded area (Pipe 2). The south end of culvert under remnant C Street has no signs of corrosion, but water flow was slightly stagnant (Photo D7). The north end of Pipe 2 is slightly corroded, possibly sliced, and a metal box with wheels is located within the pipe (Photo D8). Flow out of

the pipe was very slow, but there seems to be a second feeder, possibly from the Howard Street side of Walnut Street (Pipe 3). The runoff has lots of iron oxide flocculate and flows quickly (Photo D9), but the pipe was not found.

Other than Pipe 2 under remnant C Street, there are three more drainage pipes that connect Ditch 1 to water sources north and south of the marsh. One 48-inch CMP connects the ponds north of remnant C Street to one another (Pipe 4). Another 48-inch CMP connects the small ponds north of C Street to the ditch (Ditch 2) directly south of A Street (Photo D10; Pipe 5). There is also a 48-inch culvert located under the access road to the radio tower that runs over Ditch 1 (Photo D11; Pipe 6). All of these pipes appear to be in good condition and are transporting water.

One more culvert is located within the marsh. A 12-inch CMP, located west of the radio tower, provides a connection between the marsh south of the railroad bed and the open-water ditch to the west (Photo D12; Pipe 7).

5.3.2 Hydrology North of the Marsh



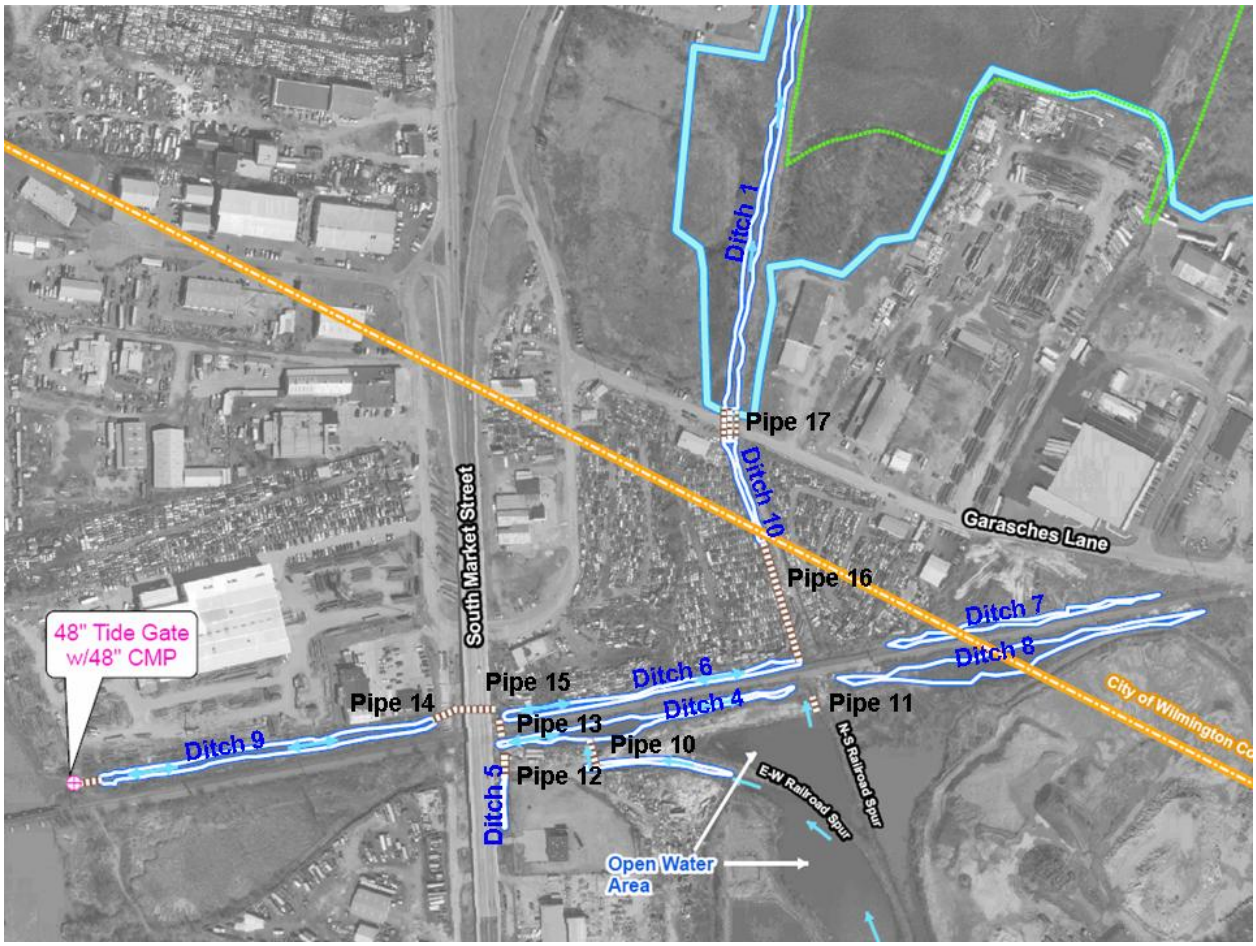
On April 4, 2007 dye was applied to Ditch 3, north of A Street, near high tide. The dye migrated upstream, south towards A Street, which leads into the marsh. This suggests that the two tide gates downstream are not completely water-tight and that some tidal flow enters this ditch. When

investigating flow south of A Street, conclusive results on flow direction in Ditch 2 and the ponds were not obtained. Therefore, the wetland north of the rail bed may be subject to inundation from Ditch 2, meeting in the northwestern corner of the wetland (Photo D13).

Ditch also receives flows from two culverts. A small 15-inch PVC pipe emanates from a new building on the east side of the ditch (Photo D14; Pipe 8). Also, a 36-inch CMP originates from under the Shell station on the west side of the ditch (Photo D15; Pipe 9). This culvert is half-covered, so may not contribute much runoff to the ditch.

5.3.3 Hydrology South of the Marsh

South of the marsh area, there is a system of culverts around the Norfolk Southern (NS) Railroad near South Market Street. Though most of the flow is west, there is a possibility of eastern flow towards the wetland area due to the failure of a tide gate. The marsh could therefore receive flow from a large open-water area to the south or directly from the tidal Christina River to the west, both of which meet in the ditches alongside the NS Railroad, east of South Market Street. The open water area will be discussed first.



The large open water area is located south of the NS Railroad, south of the abandoned east-west running railroad spur and west of the abandoned north-south running railroad spur (Photo D16). Dye testing indicates that the area is nontidal and that water flows either northerly or north

westerly towards two culverts that drain into a ditch on the south side of the NS Railroad (Ditch 4). One 36-inch CMP is located south of the abandoned east-west running railroad spur, less that 800 feet east of South Market Street (Photo D17). This culvert is approximately 75% filled with sediment, but the northern flow velocity was strong (Photo D18; Pipe 10). Another 36-inch CMP is located just west of the abandoned north-south running railroad spur (Photo D19; Pipe 11). This culvert is flowing well, allowing water to travel north into Ditch 4.

Another culvert drains into Ditch 4. A 36-inch CMP runs parallel on the east side of South Market Street and drains a ditch (Ditch 5) northerly towards Ditch 4 (Photo D20; Pipe 12). On both field visits, the flow passed north through the culvert, thus leading to the conclusion that Ditch 5 is nontidal. Pipe 12 is in good condition and seems to be flowing well.

Dye was applied in Ditch 4 on April 4, 2007 near high tide. Flow moved slowly to the east, suggesting tide was coming in. Tidal influence was confirmed on the May 4, 2007 visit during low tide, when water was quickly moving westerly. The flow connecting Ditch 4 to the northern ditch alongside the NS Railroad, east of South Market Street (Ditch 6) is also tidal. The culvert connecting these two areas looks to be a 36-inch terra cotta pipe (TCP), though a contact from Norfolk Southern has indicated that the pipe under the railroad is cast iron (Photo D21; Pipe 13). During high tide on April 4, 2007, Pipe 14 was not visible, but bubbling was noted on the northern side where the culvert was believed to be located, indicating a south-north flow. On May 4, 2007, the pipe was visible on the north side, but the south side was covered with debris. Flow moved swiftly from south to north towards the tidal Christina River.

The ditches north and south of the NS Railroad, east of the abandoned north-south running railroad spur, do not seem hydrologically connected to Ditch 4 or 6 or to each other. The ditch to the north (Ditch 7) does not seem to convey water (Photo D22), but the southern ditch (Ditch 8) is fed by the open water area (Photo D23). The water in the ditch was not visibly flowing wither direction.

The tidal Christina is located west of the study site, just north of the NS Railroad. Dye was applied to the ditch north of the NS Railroad, west of south Market Street on April 4, 2007 slightly past high tide (Ditch 9). The dye migrated slowly to the east, indicating that the tide gate where the Christina River meets with Ditch 9 does not seal completely and that the tide was still coming in.

Ditch 9 is then connected to Ditch 6, east of South Market Street by two culverts. Going east, the flow passes through a 58-inch wide by 36-inch high corrugated metal pipe arch (CMPA) to a drainage inlet (Photo D24; Pipe 14). The exposed portion of this pipe shows signs of deterioration (Photo D25). From the drainage inlet, the flow travels east through a 50-inch wide by 31-inch high CMPA (Pipe 15). The eastern end of this pipe was not found during investigations (Photo D26). During the April 4, 2007 field visit, dye applied to the ditch flowed east, suggesting tide was still coming in. On the May 4, 2007, visit, however, flow was travelling to the west. The western drainage through Pipe 14 and Pipe 15 is rather slow. Measurements taken at the site show that the solid resistance was encountered approximately 12-inches below the water level at the drainage inlet. This, along with the slow velocity through the pipe system suggests the drainage inlet and/or pipes have accumulated silt or have another form of blockage.

As mentioned above, Ditch 6 can flow two ways. One is west towards the Christina River through the Pipe 14 and 15. The other is east from South Market Street through a corrugated metal pipe (Pipe 16) that passes through an automobile junkyard across from the abandoned north-south running railroad spur. The 48-inch CMP is approximately 280 feet long and terminates into a 240-foot ditch (Photo D27; Ditch 10). Dye was placed at the inlet of Pipe 16 on April 4, 2007, but there was no evidence of water movement in the area due to little or no flow moving through the pipe and its entrance being partially blocked by numerous tires (Photo D28). Ditch 10 then connects to a triple 22-inch by 13-inch CMPA (Pipe 17) that carries flow under Garasches Lane through to Ditch 1 (Photo D29). Pipe 17 is slightly corroded and it is hard to tell if the three pipes are blocked or not due to the lack of water flowing through the area.

There may have been at one time a culvert under the railroad that passed flow from south of the railroad to Pipe 16, but all the flow south of the railroad is now diverted towards the drainage ditches along the railroad flowing west to the Christina River. It appears that this connection from the open-water area south of the NS Railroad to the ditch west of the marsh area serves little purpose today.

5.4 Surface Water Data

5.4.1 HOBO Data

Four HOBO depth loggers were installed in the ditch system leading to the South Wilmington wetland (Figure 3). One is located in the Christina River, two are located in the ditch south of A Street, and one HOBO is located in a ditch west of Market Street and north of the Norfolk Southern Railroad. All charts and the associated metadata report are located in Appendix E.

The HOBO site on the Christina River north of A Street (River Site; near Ditch 3) shows a significant tidal influence. There is evidence of 5 to 8 feet of tidal fluctuation, with low tide between -2 to -1 feet above mean sea level and high tide ranging from 3 to 6 feet above mean sea level. The average water level is 1 foot above mean sea level.

The HOBO site south of A Street at the northern end of the ditch (Ditch Site #1; in Ditch 2) also shows tidal influence, but water level is more influence by rain events. Tidal range seems to be about 0.5 feet, with a few peaks. There is an unexplained peak in flow on May 22 and September 5. Surface water elevation is decreasing over the time period due to seasonal change, with an average height of -0.6 feet above mean sea level decreasing to -1 foot above mean sea level.

The HOBO site south of A Street parallel with the Shell gas station (Ditch Site #2; in Ditch 2) shows a similar hydrograph to the previous station, just transformed a little lower above sea level (approximately 0.1 to 0.2 feet lower above sea level). Tidal range is about 0.5 feet and surface water elevation is decreasing over the time period, from -0.8 feet above mean sea level to -1.1 feet above mean sea level.

The HOBO site west of South Market Street along the Norfolk Southern Railroad (Ditch Site #3; in Ditch 9) only has a hydrograph from August to September, so it is not directly comparable to the other sites' trend lines. Also, the site experience many out-of-water incidents, so low tide elevations were not obtained. Tidal range is about 3.5 feet and water surface elevation averages

around 1.65 feet above mean sea level. It does not seem that storm events do not affect this ditch's hydrology.

All four HOBOs show that there is tidal influence in the ditches located in the South Wilmington Wetland, but the tide gates dampen the tidal range that is seen within the river, since they are not functioning properly. Even under current conditions, tidal influence is overridden by even a 0.1-inch storm event in Ditch 2, but the same storm event seems to have no effect in Ditch 9. This may be due to Ditch 2 being a lower elevation above sea level (approximately 2 to 3 feet lower), making Ditch 2 a capture area for surrounding runoff. It appears possible that, with the opening or replacement of the tide gates, tidal influence could extend throughout the ditch system. This effort, however, would have to be entertained in concert with potential adverse affects on flooding, flood attenuation, pollution control, and other factors. We also do not know if the existing culverts can physically transport water into the wetland or if the ditches along the NS Railroad could handle the water capacity associated with full tidal influence, precipitation events, and hydrologic connection with Ditch 1, 2, and 3 without overtopping the railroad tracks.

5.4.2 YSI Sonde Data

Two YSI data sondes were installed at the same locations as the HOBO depth loggers (Figure 3). One is located in the Christina River and the other is in the ditch south of A Street, parallel to the Shell gas station. Data recorded includes temperature, specific conductivity, salinity, dissolved oxygen (percent and mg/l), pH, and turbidity. All charts and the associated metadata report can be found in Appendix E. Some erroneous data were retained in the charts but ignored during analysis.

Temperature follows a similar trend at both sites, but the river, after June 5, is warmer than the ditch (approximately 70 to 83F in the river, 65 to 78F in the ditch), though the ditch temperature varies widely throughout the day. Ditch temperatures may be cooler due to rain events affecting the smaller ditch's temperature more drastically than the larger Christina River.

Specific conductivity is mostly different in the river and ditch sites. The ditch had a higher specific conductivity than the river from May 8 to June 11 (approximately 0.2 to 0.4 mS/cm at the river, 0.4 to 1.1 mS/cm at the ditch), but then the Christina River's specific conductivity became highly variable due to tidal ebb and flow and, in general, higher, most likely due to the seasonal decrease in freshwater discharge into the system, leaving the river water more brackish. It also seems that the ditch's specific conductivity is decreasing over the time period, which may be caused by a decreased tidal influence in the ditch or an increase in rain events that flushed the system.

Salinity is highly variable at both sites, ranging from 0 to 0.6 parts per thousand for the ditch site and 0 to 1 part per thousand for the river site. The river had a lower salinity than the ditch site from May 8 to June 14 (approximately 0.1 to 0.2 parts per thousand at the river, 0.2 to 0.5 parts per thousand at the ditch), but then salinity became highly variable at both sites, with salinity increasing in the river and decreasing in the ditch. Salinity in the river shows a seasonal increase due to decreased freshwater discharge into the system, while salinity is decreasing in the ditch because tidal influence may have lessened.

Dissolved oxygen concentrations seem to be, on average, higher at the river site than the ditch site (by 40% air saturation, 4 mg/L) because the river has a larger surface area. Overall, dissolved oxygen is extremely variable in the ditch when compared to the river due to temperature variations and large algal quantities, and generally in lower concentration (approximately 100% to 75% air saturation, 9 to 6 mg/L in the river; 48% to 50% air saturation, 4 mg/L in the ditch). Dissolved oxygen levels are decreasing over time in both the river and the ditch due to seasonal changes.

For pH, the ditch site is at a rather constant level at 7.5 with only a few spikes in pH, while the river site fluctuates a bit around that level. In the river, there is an increase in pH over 7.5 from May 14 to May 27 and then a slight drop below it from June 4 to June 20. The increase corresponds with an increase in dissolved oxygen, most likely pointing to an algal bloom, while the decrease may be due to the large number of storm events in June. The spike in pH at the ditch site in July corresponds to an increase in dissolved oxygen as well, most likely due to an algal bloom.

Turbidity is low at both sites, with values fluctuating more often at the ditch site due to its size. Turbidity in the river ranges mostly from 6 to 30 NTU, while the ditch ranges from 10 to 80 NTU. On average, turbidity is approximately 5 NTUs higher at the ditch site than the river site due to algal blooms. Peaks in the ditch site happened from May 26 to June 3, June 15 to June 22, June 26 to June 27, June 30, and July 2 to July 4. This can be due to either algal productivity or the presence of storm events and surface water runoff.

Though water quality parameters at the river site and ditch site vary, neither site has conditions that are detrimental to aquatic life. There is more algal production in the ditch than the river, and the ditch system is more readily affected by stormwater and runoff inputs than the river. Removing or replacing the tide gates and connecting the ditch system to the Christina from the north and west may affect the current condition of the ditch by steadying and possibly raising water temperature and increasing specific conductivity and salinity. This may affect the amount of algal blooms in the ditch, which would steady dissolved oxygen levels and turbidity. None of these changes, however, would be harmful to the system. This analysis, however, does not take into consideration the presence of contaminants in the system (PCBs, VOCs, etc.). The wetland is known to contain various hazardous materials and measures must be taken to ensure that the contaminants would not harm the Christina River or create contamination issues near or in the surrounding community.

5.5 Groundwater Data

Three groundwater wells were installed near the intersection of Howard Street and South Walnut Street (Figure 3). One is near the northwest corner of the intersection parallel to remnant C Street, while the other two are located on the north and south sides of remnant C Street, west of the ditch. Data is missing most of July due to a failure in memory capacity. All other data is missing for unknown reasons. Charts are located in Appendix E.

Well BR-1 is located near the northwest corner of Howard Street and South Walnut Street. It has a relatively high groundwater level, ranging from 0.35 to 3 feet above mean sea level. The

average water elevation ranged from 0.8 to 1.4 feet above sea level until April 15, when a large storm hit, dumping 4.36 inches in the area. Water level began decreasing after that event, with a 0.9 foot decrease from May 6 to July 11, which is a typical seasonal occurrence. Groundwater level continued to decrease through to September, where the last value recorded was near -0.05 feet above sea level.

Well BR-2 is located northeast of the intersection of remnant C Street and South Walnut Street. The hydrograph from this well looks more volatile than the other two wells. Groundwater elevation ranges from -0.6 to 3.25 feet above mean sea level. The average water elevation before April 16 ranged from 0.4 to 1.2 feet above mean sea level, with a gradual decline from 0.65 feet above mean sea level at the end of May to -0.6 feet above mean sea level by early July. The portion of the hydrograph after May 27 is more variable than the rest of the hydrograph and does not seem to match the data from the other wells, though it follows the same average trajectory. The reason for the oscillation in the data is unknown, but could be related to the construction going on in the immediate area. Groundwater levels continued to decline to an average of -0.5 feet above sea level in late September.

Well BR-3 is located south of remnant C Street, midway between South Walnut Street and the ditch. Groundwater elevation ranges from -0.84 to 3.1 feet above mean sea level. The average water elevation before April 16 ranged from -0.4 to 0.6 feet above mean sea level, with a decline from -0.2 to -0.84 feet above mean sea level from mid may to early July. There is a large amount of missing data from early May to June for unknown reasons. However, the overall groundwater elevation trend matches closely with that of Well BR-1 until mid August, where Well Br-3 experiences a groundwater high, followed by a low within the course of six days (groundwater elevation change of 1.47 feet above mean sea level). The reason for this fluctuation is unknown, but may also be related to the construction going on in the area. Water level continued to decrease through September, where the last recorded value was near -1.20 feet above sea level.

Based on these groundwater elevations, it would seem that there is recharge west of Walnut Street that flows east toward Ditch 1. This is supported by the fact that there is a low area west of Well BR-1 that accumulates surface water. Since groundwater elevations range from -0.84 feet to 3.25 feet above mean sea level at the two wells near the marsh, it is likely that a created wetland can tie into groundwater sources as well as surface water sources.

6.0 CONCLUSIONS

6.1 Wetland Assessment

The field observations and the wetland assessment both indicate that the existing wetland provides excellent sediment stability and good water quality benefits, but poor habitat for fish and wildlife. The features of the existing wetland that most limit its habitat potential are its monotypic vegetation community, its limited physical habitat diversity, and the presence of contaminants. Analysis of the element scores within the functional capacity assessment models provides insight into these limiting factors, which then can be incorporated in a restoration design to optimize wetland functions. The assessment suggests that an increase in vegetative diversity and structure and the creation of open-water habitat would improve the existing marsh, as would greater connectivity to adjacent surface waters, including tidal flushing, and the removal of contaminated debris. Changes to the existing wetland intended to improve habitat may, however, lead to decreases in the sediment stabilization or shoreline erosion control capacity of the wetland. A trade-off is likely in any restoration design. Therefore, the results of this wetland assessment should be placed in the context of the greater goals of the South Wilmington Special Area Management Plan. Since the objective of this project is to discuss the feasibility of restoring the marsh, and to increase stormwater management opportunities, the feasibility of reconnecting the wetland to the Christina River or the open water area to the south should be analyzed.

6.2 Hydrologic Assessment

The results of the field investigations show that there is a limited tidal connection from the Christina River to the South Wilmington Wetland. From the west, drainage south of NS Railroad is directed into the drainage ditches paralleling the railroad and towards the Christina River to the west of South Market Street. The only time that some of the flow from the south of NS Railroad bypasses the drainage ditches along the railroad would be during storms events when the water level becomes high enough to overtop the railroad. From the north, drainage from the Christina enters through the broken tide gate to the ditch that runs parallel to the western side of the marsh. Both of these areas show the opportunity for tidally connecting the marsh, but the northern entrance seems more feasible due to less physical blockages (within the pipes and the NS Railroad).

The tide gate inspections and surface water data show there is tidal influence in the ditches located in the South Wilmington Wetland, but the tide gates dampen the tidal range that is seen within the river. It is possible that, with the opening of the tide gates, that tidal influence could extend throughout the ditch system. We do not know, however, if the existing culverts can physically transport water into the wetland or if the ditches along the NS Railroad could handle the water capacity associated with full tidal influence without overtopping the railroad tracks.

It is important to note that fixing the tide gates could cost up to $70,000 initially, with $7,000 worth of maintenance annually. From a preliminary look at the culvert and ditch system in the area, current tidal influence would most likely come from the northern ditch connection to the Christina River. There is also a water influence coming from a western recharge area, as seen in the groundwater data, which shows that wetland design will be affected by western development and runoff. It may not be monetarily or physically feasible to connect the wetland to the western tide gate due to a current lack of connection south of the Norfolk Southern Railroad to the north and no current evidence of flow north toward the marsh from this area.

No connections were found from the marsh to the communities of South Wilmington. If, however, the wetland will be used for stormwater management purposes, the increased water in the area from full tide may hydrologically connect this are to the eastern community area. This may open the opportunity for using the marsh as stormwater management for the communities as well, but it could also increase flooding problems in the area, though this is unlikely since most of the problems found in the *South Wilmington Drainage Study* pointed to debris accumulation and undersized pipes as the problem (2006). However, if this is the most feasible option, then it may be beneficial to install another tide gate to the north of A Street, near the wetland/community boundary. This could act to not only facilitate in flushing the northern end of the marsh, but it will help mitigate flooding issues in the community. An H&H study will be needed to analyze the effects of increasing water levels in the wetland.

6.3 Future Needs

Before planning can begin within the wetland, the condition of wetland soils must be analyzed for contamination. If contaminated, state agencies need to be consulted about the location and cost of disposal. It is also important to define the limits of the wetland. This is currently being completed through a contract with the City of Wilmington.

In addition, an H&H study must be conducted to confirm the best way to connect the wetland to the Christina River. The following is a list of survey requirements for conducting a hydraulic analysis of the drainage system in the vicinity through South Wilmington Wetland. Refer to the figures in section 5.3, “Dye Test Results and field Observations”, for location of the ditches and pipes identified below:

From Christina River to Market Street Along Ditch 9 on North Side of NS Railroad:

1. Obtain invert elevations on east and west ends of the pipe connected to the tide gate, a reinforced concrete pipe (RCP) at western end of ditch.

2. Obtain four cross-sections at 100-foot intervals along Ditch 9 north of NS Railroad. Information shall include, at a minimum, the invert of the ditch, the width of the ditch, and top-of-bank elevations. Cross-sections shall extend to 10 feet beyond the top of bank on both sides.

Below Market Street Overpass:

3. Obtain type, size and length, and invert elevations of Pipes 14 and 15 at the east and west ends of the culvert system under Market Street. Obtain size if inlet and invert elevations of pipes entering and exiting the storm drain inlet under the Market Street overpass.

Pipes Just East of Market Street:

4. Obtain invert elevations on both north and south ends of Pipe 13, a culvert under NS Railroad just east of Market Street. Also obtain size and type for this culvert.

5. Obtain invert elevations on both north and south ends of Pipe 12, located at end of ditch paralleling Market Street. This pipe is shortly upstream of Pipe 13. Also obtain size, type and length of this culvert.

Ditch 4 on South Side of NS Railroad:

6. Obtain seven cross-sections at 100-foot intervals along Ditch 4 on south side of NS Railroad. Information shall include, at a minimum, the invert of the ditch, the width of the ditch, and top-of-bank elevations. Cross-sections shall extend to 10 feet beyond the top of bank on the both sides.

7. Obtain invert elevations, type, size and length of Pipe 11, a culvert located approximately 700 feet east of Market Street on the south side of the NS Railroad.

Ditch 6 on North Side of NS Railroad:

8. Obtain seven cross-sections at 100-foot intervals along Ditch 6 on south side of NS Railroad. Information shall include, at a minimum, the invert of the ditch, the width of the ditch, and top-of-bank elevations. Cross-sections shall extend to 10 feet beyond the top of bank on the both sides.

9. Obtain invert elevations, type, size and length of Pipe 16, a culvert located approximately 700 feet east of Market Street on the north side of the NS Railroad.

Ditch on South Side of Old Railroad Spur:

10. Obtain three cross-sections at 100-foot intervals along the ditch along the old railroad spur. Information shall include, at a minimum, the invert of the ditch, the width of the ditch, and top-of-bank elevations. Cross-sections shall extend to 10 feet beyond the top of bank on the south side and to the middle of the railroad spur on the north side.

11. Obtain invert elevations at the north of south ends, type, size and length of Pipe 10, a culvert under the old railroad spur.

Ditch 10 South of Garasches Lane

12. Obtain three cross-sections at 100-foot intervals along Ditch 10. Information shall include, at a minimum, the invert of the ditch, the width of the ditch, and top-of-bank elevations. Cross-sections shall extend to 10 feet beyond the top of bank on both sides.

13. Obtain invert elevations at the north of south ends, type, size and length of Pipe 17, a triple-celled culvert under Garasches Lane.

Ditch 1 from Radio Tower Access Road to Garasches Lane

14. Obtain seven cross-sections at 100-foot intervals along Ditch 1. Information shall include, at a minimum, the invert of the ditch, the width of the ditch, and top-of-bank elevations. Cross-sections shall extend to 10 feet beyond the top of bank on both sides.

15. Obtain invert elevations at the north of south ends, type, size and length of Pipe 6 and 7, a culvert under the access road to the radio tower and one southeast of it.

Ditch 1 from Remnant C Street to Radio Tower Access Road

16. Obtain three cross-sections at 100-foot intervals along Ditch 1. Information shall include, at a minimum, the invert of the ditch, the width of the ditch, and top-of-bank elevations. Cross-sections shall extend to 10 feet beyond the top of bank on both sides.

17. Obtain invert elevations at the north of south ends, type, size and length of Pipe 2, a culvert under Remnant C Street, and Pipe 1, a culvert under remnant C Street, north of the radio tower.

Ditch 2 from A Street to Remnant C Street

18. Obtain six cross-sections at 100-foot intervals along Ditch 2 and the two ponded areas. Information shall include, at a minimum, the invert of the ditch and ponds, the width of the ditch and ponds, and top-of-bank elevations. Cross-sections shall extend to 10 feet beyond the top of bank on both sides.

19. Obtain invert elevations at the both ends, types, sizes and lengths of Pipes 4 and 5, culverts within the marsh.

Vicinity of A Street

20. Obtain invert elevations at the both ends, types, sizes and lengths of Pipes 8 and 9 and the two culverts under A Street, connecting to the tide gates.

A detailed assessment of the pipe hindrances should also be conducted before planning to reconnect the wetland to any other water source. It is therefore recommended that these pipes be investigated using CCTV or other suitable method. This especially includes Pipes 10, 14, 15, and

16. Monitoring of wetland surface water/groundwater levels may also be necessary to gain an accurate picture of flow patterns through the marsh itself.

Once the hydrologic investigation is completed, designs can be created that can feasibly connect the wetland to the tidal Christina River. A dialogue with the City and agencies about stormwater management needs versus park needs will ultimately define the area's design.

7.0 REFERENCES

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